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VOL. CXXXVI.—No. 3540] LONDON: FRIDAY EVENING, NOVEMBER 2, 1923 [PRICE {WITH SUPPLEMENT} ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director - General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, REQUIRES :—
1. VOLUTE AND HELICAL SPRINGS.
2. COPPER PLATES FOR FIRE-BOXES.
3. WROUGHT IRON BOLTS AND NUTS.
4. MILD STEEL RIVETS.

Tenders due on the 15th November, 1923.
Tender forms obtainable from above. 3982

Aberdeen Corporation Water-Works.
EXTENSIONS, 1920.
CONTRACT NO. 14.—NEW AQUEDUCT.

The Town Council of Aberdeen are prepared to receive TENDERS from competent persons willing to enter into a contract for the MANUFACTURE and DELIVERY of about 7 MILES of 40in. diameter PIPES and SPECIALS of the following alternative types, viz.:—
(a) CAST IRON.
(b) MILD STEEL (Lap-welded).
(c) REINFORCED CONCRETE (Spun and Ordinary).

The drawings may be inspected and specification, schedule of quantities, and form of Tender obtained on and after 7th November, 1923, on application at the Water Engineer's Office, 41½, Union-street, Aberdeen. Early application is desirable and no specification will be given out after 16th November.

For each specification a deposit of Five Pounds sterling will be required, which sum will, after a Tender has been accepted, be returned to the tenderer, provided that he shall have sent in a bona fide Tender, based on the drawings, specification, and schedule of quantities provided, with the schedule of quantities fully priced out in detail, and shall not have withdrawn the same.

The employment of labour shall be in accordance with the conditions of the Unemployment Grants Committee.

Tenders, on the forms prescribed and enclosed in securely sealed envelopes, endorsed "Tender for New Aqueduct Piping," are to be addressed to the undersigned. No Tender delivered after 9 p.m. on 26th November, 1923, will be considered.

The Town Council do not bind themselves to accept the lowest or any Tender.

GEORGE MITCHELL, M. Inst. C.E., F.G.S., Water Engineer.

Water Engineer's Office, 41½, Union-street, Aberdeen, 23rd October, 1923. 3919

Aberdeen Corporation Water-Works.
EXTENSIONS, 1920.
CONTRACTS NOS. 15 AND 16.—NEW AQUEDUCT.

The Town Council of Aberdeen are prepared to receive TENDERS from competent persons willing to enter into a contract for the TRANSPORTING, LAYING, and JOINTING of about 7 MILES of 40in. PIPING and ANCILLARY WORKS between Crathes and Culter.

The drawings may be inspected and specification, schedule of quantities, and form of Tender obtained on and after 7th November, 1923, on application at the Water Engineer's Office, 41½, Union-street, Aberdeen. Early application is desirable, and no specification will be given out after 16th November.

For each specification a deposit of Five Pounds sterling will be required, which sum will, after a Tender has been accepted, be returned to the tenderer, provided that he shall have sent in a bona fide Tender, based on the drawings, specification, and schedule of quantities provided, with the schedule of quantities fully priced out in detail, and shall not have withdrawn the same.

The employment of labour shall be in accordance with the conditions of the Unemployment Grants Committee.

Tenders, on the forms prescribed, and enclosed in securely sealed envelopes, endorsed "Tender for Aqueduct Pipe Laying," are to be addressed to the undersigned. No Tender delivered after 5 p.m. on 26th November, 1923, will be considered.

The Town Council do not bind themselves to accept the lowest or any Tender.

No person should Tender unless thoroughly experienced in the actual construction of extensive public works.

GEORGE MITCHELL, M.Inst.C.E., F.G.S., Water Engineer.

Water Engineer's Office, 41½, Union-street, Aberdeen, 23rd October, 1923. 3920

Bombay, Baroda, and Central India Railway Co.

The Directors are prepared to receive up to Noon on Friday, 23rd November, TENDERS for the SUPPLY of :—
1. COVERED GOODS WAGONS.
2. WHEELS AND AXLES FOR WAGONS.

Tenders must be made on forms, copies of which, with specification can be obtained at these offices on payment of 20s. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG, Secretary.

Offices : 91, Petty France, Westminster, S.W. 1, 31st October, 1923. 4027

East Indian Railway.

The Directors are prepared to receive up to 11 a.m. on Wednesday, the 21st instant, TENDERS for the SUPPLY of :—
ELECTRIC OVERHEAD TRAVELLING CRANES.

Copies of the specification can be obtained at the Company's offices on payment of £1 1s. each. This fee will not be returned.

G. E. LILLIE, Secretary.

73/76, King William-street, London, E.C. 4. 1st November, 1923. 4031

Torquay Town Council.
WATERWORKS DEPARTMENT.

The Council of the Borough of Torquay is prepared to receive TENDERS for the MANUFACTURE and DELIVERY of about 2100 TONS of 14in., 12in., and 7in. diameter CAST IRON PIPES and SPECIAL CASTINGS.

Specifications and schedules may be obtained on application to the undersigned on payment of a deposit of Two Guineas, which will be returned on receipt of a bona fide Tender.

Sealed Tenders, endorsed "Tender for Pipes," are to be addressed to the Town Clerk, Municipal Offices, Torquay, and delivered before Noon on Thursday, 15th November, 1923.

The Council do not bind themselves to accept the lowest or any Offer.

SAMUEL O. CHAPMAN, M. Inst. C.E., Waterworks Engineer.

Municipal Offices, Torquay, 31st October, 1923. 4021

The Engineer

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L.M. & S. Railway New Tank Engine.

PUBLIC NOTICES

Metropolitan Water Board.
TENDERS FOR THE SUPPLY AND ERECTION OF TWO RECIPROCATING ENGINES AND PUMPS AT KEMPTON PARK PUMPING STATION, MIDDLESEX.

The Metropolitan Water Board invite TENDERS for the SUPPLY and ERECTION of TWO TRIPLE-EXPANSION DIRECT-ACTING, RECIPROCATING, ROTARY TYPE PUMPING ENGINES, cylinders approximately 30in., 46in., and 86in. diameter by 5ft. 6in. stroke, at their Kempton Park Pumping Station, Middlesex.

Forms of Tender, conditions of contract, specification and drawings may be inspected without payment of fee at the offices of the Board (Room 173), Chief Engineer's Department, 173, Rosebery-avenue, Clerkenwell, E.C. 1, on and after Thursday, 1st November, 1923.

Contractors desirous of tendering may obtain the necessary documents from Mr. Henry E. Stillgoe, M. Inst. C.E., the Chief Engineer, on production of an official receipt for the sum of Three Guineas, which sum must be deposited with the Board's Accountant and will be returned on receipt of a bona fide Tender, together with all incidental papers. Such payments and applications must be made between the hours of 10 a.m. and 4.30 p.m. (Saturdays, 10 a.m. and 12 noon). Cheques must be made payable to the "Metropolitan Water Board" and not to individuals.

Tenders, enclosed in sealed envelopes, addressed to "The Clerk of the Board, Metropolitan Water Board, 173, Rosebery-avenue, E.C. 1," and endorsed "Tender for Machinery, Kempton Park," must be delivered at the offices of the Board not later than 10 a.m. on Monday, 31st December, 1923.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER, Clerk of the Board.

Offices of the Board, 173, Rosebery-avenue, E.C. 1, 22nd October, 1923. 3923

Port of Bristol.
CONSTRUCTION OF EASTERN ARM OF ROYAL EDWARD DOCK.
PRELIMINARY NOTICE.

The Docks Committee expect to shortly invite TENDERS for the CONSTRUCTION of the EASTERN ARM of the ROYAL EDWARD DOCK, AVONMOUTH.

The work will consist principally of the removal and carrying to spoil of the main excavation for the arm of the Dock, together with the construction of a ferro-concrete built wharf about 1700ft. long on each side; also the construction of two three-floor ferro-concrete built transit sheds, each 500ft. long; and a ferro-concrete built silo granary of about 6000 tons capacity.

The complete plans and specification will be ready early in December, but in order to provide employment at the earliest possible date it will be necessary that the Tenders should be received early in January. This preliminary notice is, therefore, issued so that intending tenderers may make an inspection of the site as soon as possible after Monday, 12th November, when they can obtain such of the drawings and schedules of prices as may be ready at the time.

The complete specification, schedules of prices and contract drawings will be sent early in December to all applicants on production of a receipt showing that a deposit of £15 has been paid to the Bristol Docks Committee, 19, Queen-square, Bristol, to whom all cheques must be made payable. The deposit of £15 will be returned hereafter to all bona fide tenderers.

Communications for an inspection of the site, &c., should be sent to the undersigned as early as possible.

The Docks Committee do not bind themselves to accept the lowest or any Tender.

THOMAS A. PEACE, Chief Engineer, Port of Bristol.

Chief Engineer's Office, Avonmouth Docks, 31st October, 1923. 4022

PUBLIC NOTICES

Metropolitan Borough of Bermondsey.
NEW BATHS AND WASH-HOUSES.
MACHINERY, BOILERS, ENGINE-ROOM PLANT.

The Bermondsey Borough Council are prepared to invite TENDERS for the ENGINEERING PLANT for their New Baths and Wash-houses, Grange-road. Firms wishing to Tender for one or more of the following three sections, viz.:—
1. PUBLIC LAUNDRY EQUIPMENT.
2. BOILER-ROOM EQUIPMENT.
3. ENGINE-ROOM EQUIPMENT.

are requested to send their names to the undersigned, together with references to similar recent work carried out by them at other public baths, not later than Twelve Noon on Monday, the 12th November, 1923. Plans showing the proposed extent of the work, with copy of general conditions, form of contract and bonds to be entered into, can be inspected at the Town Hall, Spa-road, S.E., on application to the Borough Engineer. Selected firms will be provided with a set of plans, specification, and form of Tender, upon payment of a sum of One Guinea, which deposit will be returned on receipt of a bona fide Tender.

FREDK. EYALL, Town Clerk.

Town Hall, Spa-road, S.E. 16, 27th October, 1923. 3905

The Madras and Southern Mahratta Railway Company, Ltd.

The Directors are prepared to receive TENDERS for :
(1) 150 COVERED GOODS WAGONS, 4-Wheeled, I.R.C.A. Standard Type, A. 2 ;
(2) 107 TONS SPRING STEEL ;
(3) METALS (comprising Brass Wire and Tubing, Copper Ingots, Rods, Tubes, Sheets, &c., Antimony, &c.) ;

in accordance with the specifications, which may be seen at the offices of the Company. The charge for each specification is One Guinea, which will not be returned. Tenders must be sent in, addressed to the SECRETARY, not later than 2 p.m. on Tuesday, 20th November, 1923, and marked "Tender for C.G. Wagons," or as the case may be.

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices : 25, Buckingham Palace-road, Westminster, S.W. 1, 30th October, 1923. 4025

The South Indian Railway Company, Limited, are prepared to receive TENDERS for the SUPPLY of :—
1. LOCOMOTIVE BOILERS.
2. WATER CRANES, &c.
3. PLATE GLASS, &c.
4. LINOLEUM.
5. CANVAS.
6. LAMP GLASSES, &c.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Locomotive Boilers," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 30th November, 1923, in respect of Specifications Nos. 1 and 2, and not later than Twelve Noon on Friday, the 14th November, 1923, in respect of Specifications Nos. 3, 4, 5, and 6.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of £1 for each copy of Specification No. 1 ; of 5s. for each copy of Specifications Nos. 2, 3, 4, and 5 ; and of 2s. 6d. for each copy of Specification No. 6.

Copies of the drawings may be obtained at the offices of Messrs. Robert White and Partners, Consulting Engineers to the Company, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD, Managing Director.

91, Petty France, Westminster, S.W. 1, 30th October, 1923. 4016

PUBLIC NOTICES

Great Northern Railway (Ireland).
TO BRIDGE CONTRACTORS.

The Directors are prepared to receive TENDERS for RECONSTRUCTION of a STEEL VIADUCT at Annaghkilly, between Newbliss and Clones.

The drawings and specification may be inspected at the Engineer's Offices, Dublin and Belfast, and copies of same, together with bills of quantities and forms of Tender, may be obtained from the undersigned on payment of Two Guineas, which will be refunded on receipt of a bona fide Tender accompanied by the drawings.

Tenders, made out on forms supplied by the Company, should be delivered under sealed cover, endorsed "Tender for Bridge Work," not later than 10 a.m. on Saturday, 17th November.

The Directors do not bind themselves to accept the lowest or any Tender.

J. B. STEPHENS, Secretary.

Amiens-street Station, Dublin, 30th October, 1923. 4010

Great Northern Railway (Ireland).
TENDERS FOR LOCOMOTIVES.

The Directors are prepared to receive TENDERS for FIVE GOODS ENGINES with TENDERS, and FIVE TANK ENGINES,

in accordance with the Company's drawings and specifications, copies of which can be obtained on application to the undersigned upon payment of £2, which will be refunded on receipt of a bona fide Tender and return of the drawings and specifications.

Tenders, made out on the forms supplied by the Company, should be delivered, under sealed cover, endorsed "Tender for Locomotives," not later than 10 a.m. on December 3rd.

The Directors do not bind themselves to accept the lowest or any Tender.

J. B. STEPHENS, Secretary.

Amiens-street Station, Dublin, 31st October, 1923. 4011

Southborough Urban District Council.
WATER MAINS, &c.

The Southborough Urban District Council invite TENDERS for the PROVISION and LAYING of about 1550 YARDS of 6in. CAST IRON WATER MAIN with SCREW-DOWN HYDRANTS, SLUICE VALVES, and SPECIAL JUNCTIONS, at Southborough, in accordance with the plans and specification prepared by the Engineers, Messrs. G. and F. W. Hodson, of Bank Chambers, Loughborough and London.

Plans and specifications may be inspected at the Council Offices, Southborough, and schedules of quantities may be obtained from the Engineers on deposit with them of the sum of £5 5s., which will be returned after the receipt of a bona fide Tender and the papers.

Tenders, on the form provided, in sealed envelopes, addressed to the undersigned and endorsed "Tender for Water Mains," must be delivered at the Council Offices, Southborough, on or before Monday, the 19th day of November, 1923.

The Council do not bind themselves to accept the lowest or any Tender.

Dated this 27th day of October, 1923.

W. N. WOOD, Clerk to the Council.

Council Offices, Southborough. 3966

State Electricity Commission of Victoria.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Morwell Power Scheme.

Copies of Tender form and specification will be available upon application to—
Agent-General for Victoria, Melbourne-place, Strand, London, W.C. 2.

SPECIFICATION NO. 24/2. — TRANSFORMERS, SWITCHGEAR AND ACCESSORIES, SUB-STATION "B."

CHARGE.—£2 2s for the first three copies of Tender form, conditions of contract, specification, and drawings complete. This charge will be returned on receipt of a bona fide Tender. A fourth copy and any further copies will be supplied for the sum of 10s. 6d. each. This charge is not returnable.

PRELIMINARY DEPOSIT.—A preliminary deposit of £100 is to be lodged with Tender. The specifications may be inspected at the above-mentioned office.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders, on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than Noon, 19th January, 1924.

R. LIDDELOW, Secretary, State Electricity Commission of Victoria, Melbourne, Victoria, Australia. 3923

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PUBLIC NOTICES

The Great Indian Peninsula RAILWAY COMPANY, 48, Copthall-avenue, London, E.C. 2, invite TENDERS for :—
STEAM COALING CRANES.....Fee £1
Tenders are due by 11 a.m. on 20th November, 1923. Tender forms obtainable at above address. Fees not returnable. 4007

Urban District Council of POULTON-LE-FYLDE.
SEWERAGE SCHEME.
CIVIL ENGINEERS and SURVEYORS are invited to write to the Clerk to the Council stating their experience and upon what terms they would PREPARE a comprehensive SCHEME and REPORT and FURNISH the necessary PLANS, SPECIFICATIONS and approximate ESTIMATES for SEWERING the area under the Council's control. Particulars as to the present sewerage scheme may be obtained from Mr. E. Prescott, Surveyor, at the Council Offices, Poulton-le-Fylde. Sealed applications, endorsed "Sewerage Scheme," are to be delivered to the Clerk to the Council on or before the 5th day of November, 1923.
J. R. GAULTER,
Clerk to the Council.
20th October, 1923. 3904

SITUATIONS OPEN

WANTED, ELECTRICAL ENGINEER, Take Full Charge of Power Plant, East Africa ; 1100 K.W. turbo-generator (Ljungstrom), boiler-house and about 35 motors.—For particulars apply, Room 31, Temple House, Tallis-street, London. P8266 A

WANTED.—WANTED, ASSISTANT WORKS MANAGER in company employing 2000 to 3000 hands near London. Must have had first-class experience on fine tool work, high-grade mass production of mechanical and cabinet work, and be conversant with latest shop methods and organisation. Only engineers having these qualifications and executive ability need apply. Adequate salary will be paid.—Address, stating age and experience, 4012, The Engineer Office. 4012 A

ASSISTANT ELECTRICAL ENGINEER REQUIRED for Iron and Steel Works Department. Must have had experience in High-tension Work and preferably in Electrical Equipment of Modern Rolling Mills and Blast-furnaces.—Full particulars of technical and practical experience, also salary required, to be sent to the SECRETARY, Consett Iron Co., Ltd., Consett. 4009 A

ASSISTANT to WORKS MANAGER. Well-educated young man, about 25/30. Preferably B.Sc. degree and good draughtsman. State in full qualifications and previous experience, if any.—Address, P8260, The Engineer Office. P8260 A

CAPABLE ASSISTANT REQUIRED, to Design and Estimate for General Constructional Steel Work. Experience of London Building Act essential. Must be rapid and accurate. State age, experience, salary, &c.—Address, 4019, The Engineer Office. 4019 A

REQUIRED, Experienced ENGINEER SALESMAN, by a well-known Engineering Company in London.—Address, giving age, experience, salary required, and full details, 4018, The Engineer Office. 4018 A

SELLING ENGINEER for Well-known Medium Compression Oil Engines. London district. Good appearance essential. Give full particulars.—Address, 3970, The Engineer Office. 3970 A

TEMPORARY JUNIOR CIVIL ENGINEERING ASSISTANT WANTED, with sound technical education and some experience in Structural Work. Salary at the rate of £260 to £240, according to qualifications. No testimonials or specimens to be sent in the first instance.—Apply, CITY ENGINEER, Hull, on or before 12th November. 4024 A

WORKS MANAGER WANTED in Midlands for Large Constructional and Bridge Works. Must have had good experience as manager and also a thorough knowledge of estimating wages costs and of piecework. Only those who have held exactly similar position need apply. State wages. Address, 3963, The Engineer Office. 3963 A

WORKS MANAGER WANTED for Motor Cycle Works of 150/200 hands. Must be a thorough engineer with experience of Motor Cycle Work and have occupied a similar position. Applicants must have organising ability above the average and able to get production out to time and to price. Moderate salary at first, but the position will probably hold excellent future prospects.—Address, giving full details of training, positions occupied, whether at present disengaged, age, and salary required. 4023, The Engineer Office. 4023 A

WANTED, DRAUGHTSMEN ; Must Have Several years' experience of Reinforced Concrete Design. —Apply by letter, stating age, qualifications, and salary required, to the SECRETARY, The British Reinforced Concrete Engineering Co., Ltd., 1, Dickinson-street, Manchester. 4002 A

WANTED, First-class DRAUGHTSMAN with Up-to-date experience in Hydraulic Machine Tools and Rubber Machinery.—Apply, giving particulars of experience, age, and salary required, to HENRY BERRY and CO., Ltd., Leeds. None but fully qualified men need apply. 4005 A

A JUNIOR DRAUGHTSMAN REQUIRED for General Engineering Work in an industrial establishment in the Eastern Counties. One who has served his time in the shops and has been at least two years in drawing-office. State age, experience, and wages required.—Address, P8240, The Engineer Office. P8240 A

CHIEF DRAUGHTSMAN REQUIRED for General Engineering Works in Berkshire, to Take Charge of Drawing-office and be responsible for estimating ; must have experience in Screening and Washing Plants, Conveyors, Elevators, and Structural Steel, Plating and Foundry Work. Salary £7 10s. per week.—State fully, in writing, experience to "J. K.," c/o Charles Barker and Sons, Ltd., 31, Budge-row, E.C. 4. 4017 A

DRAUGHTSMAN for Airscrew Design REQUIRED at the Royal Aircraft Establishment. Must have good technical and works training and actual experience of airscrew work. Salary about 70s. p.w. plus cost of living bonus, giving a present total of 106s. 5d.—Apply (quoting A22), with full particulars, to SUPERINTENDENT, R.A.E., South Farnborough, Hants. 3994 A

DRAUGHTSMAN for Chemical Works in East London ; one with experience in Tar Distillery Works preferred.—Address, stating age, experience, and salary required. 3993, The Engineer Office. 3993 A

DRAUGHTSMAN (Leading). Thoroughly Accustomed to Steel Roof and Constructional Work. Must be good designer, quite familiar with, able to produce and make practical use of stress diagrams. Must have had real experience. State age, wages, when disengaged, and full particulars.—Address, 3998, The Engineer Office. 3998 A

DRAUGHTSMEN REQUIRED for Light Railway Work, capable of design, estimating ; knowledge of structural work preferred. State experience, salary. —Address, 3972, The Engineer Office. 3972 A

DRAUGHTSMEN REQUIRED for the Midlands, with experience in Gas Plants. State age, salary required.—Address, 3971, The Engineer Office. 3971 A

EXPERIENCED DRAUGHTSMEN REQUIRED for temporary positions, accustomed to the designing of Girder Work and other Constructional Work, Calculations of Stresses, &c.—Apply by letter to W. H. WILLIAMS, Divisional Engineer's Office, L.M. and S. Railway, Crewe, stating age, experience, and salary required. 3984 A

SITUATIONS OPEN (continued)

DRAUGHTSMAN WANTED, Accustomed to Gas and Oil Plant and Distillation Apparatus.—Address, 3987, The Engineer Office. 3987 A

FIRST-CLASS DRAUGHTSMAN REQUIRED, Experienced in all classes of Crane Work. Estimating experience desirable.—State age, experience in detail, and salary, with copies of testimonials, to CHIEF ENGINEER, Stothert and Pitt, Ltd., Bath. 4020 A

SEVERAL Experienced DRAUGHTSMEN REQUIRED by Aircraft Firm. State qualifications, experience, and salary required.—Address, 3964, The Engineer Office. 3964 A

WANTED, a WATERWORKS FOREMAN for Spain, about 40 years of age, of robust health, and married. Must be practical pipe and service layer, experienced in distribution and waste water inspection. Applicants to state age, experience, and wages expected, also enclose copies of testimonials. House and lighting free. Knowledge of Spanish essential.—Write, E. M., c/o J. W. Vickers and Co., Ltd., 5, Nicholas-lane, E.C. 4. 3965 A

REQUIRED for the Far East, MACHINE SHOP FOREMAN for General Engineering Works. Preferably single man.—Apply by letter only to MACKENZIE and CO., Ltd. (China), 4, Lloyd's-avenue, E.C. 3. 3983 A

WANTED, a Good Trained MECHANIC, with Considerable experience in Testing and Running Semi-Diesel Engines and capable of erecting engines on site and starting up.—Address, stating age, experience, and full particulars, 4013, The Engineer Office. 4013 A

WANTED for a Gasworks in Kent, Good All-round MECHANIC ; Turning, Fitting, and good Electrical knowledge essential ; used to Electric Stoking Machinery.—Address, 4015, The Engineer Office. 4015 A

SITUATIONS WANTED

A SUCCESSFUL ENGINEER-MANAGER, of Proved ability, OFFERS his SERVICES as Assistant Works Manager, Departmental Manager, or similar responsible position. Keen, energetic, tactful control of labour. Salary not first consideration. Interview desired.—Address, P8245, The Engineer Office. P8245 B

A.M.I.C.E. (33), Railway Locomotive Works, D.O., charge of locomotive steam sheds, automobile and general engineering, maintenance of plant, constructional, commercial experience, wide technical knowledge, speciality, organisation and control of large staffs, DESIRES POST, works or office ; small salary to commence.—Address, P8263, The Engineer Office. P8263 B

ADVERTISER (Age 27) DESIRES POSITION as INSPECTOR of STEEL CASTINGS ; previous experience, home or abroad ; engineering training.—Address, P8259, The Engineer Office. P8259 B

CIVIL ENGINEER, University Education, Chemical section, age 30, varied experience, Swedish, Danish, Norwegian, German, English, some French, REQUIRES POSITION, England or abroad.—Address, P8220, The Engineer Office. P8220 B

CIVIL ENGINEER (31), B.Sc., A.M.Inst.C.E., SEEKS POST. Experience, home and abroad, design and construction of railways, roads, bridges, steel work buildings, water and sewage works, also workshop experience. Used to handling labour. Capital available.—Address, P8233, The Engineer Office. P8233 B

ENGINEER, Commercial, Practical, Late Sheffield tool firm, live connection Southern Counties, DESIRES APPOINTMENT, established firm.—Address P8255, The Engineer Office. P8255 B

ENGINEER and Qualified DRAUGHTSMAN (35), fifteen years' experience, home and abroad, DESIRES to get in touch with Mining or Oil Company who can offer him POSITION of TRUST either home or abroad. Experience : maintenance, construction, plant erection, or drawing-office.—Address, P8174, The Engineer Office. P8174 B

ENGINEERS' REPRESENTATIVE (35), Now Disengaged, understands mining, quarry, and industrial plants, qualified engineer and well known Swindon to Penzance, DESIRES APPOINTMENT.—Address, P8175, The Engineer Office. P8175 B

ENGINEER, with Experience in the Design, Manufacture, and running of tar-macadam machinery, REQUIRES CHANGE.—Address, P8244, The Engineer Office. P8244 B

ENGINEER, Age 32, 16 Years' Thorough Practical and technical experience in general engineering, DESIRES CHARGE, Factory, Contract, or Plant ; qualifications sent with pleasure.—COUMBE, 98, Crouch-hill, London, N. 8. P8252 B

M.I. MECH. E. OPEN, on Completion of Agreement, for POST, home or abroad. Twenty years' experience (ten years N. America) in design, construction, and installation of power, refrigeration, materials handling, crushing and grinding plants, ferro-concrete and steel design and construction, works management and commercial experience.—Address, P8246, The Engineer Office. P8246 B

PLANNING ENGINEER OPEN to APPOINTMENT. Particularly experienced in tools and methods for the repetition production of telephone and radio apparatus.—Address, P8247, The Engineer Office. P8247 B

RAILWAYS, LIGHT, HEAVY.—ADVERTISER (37), wide experience, SEEKS POST, Consulting, Manufacture, Suppliers or Maintenance ; used to control, good draughtsman, accustomed to home, colonial, foreign works.—Address, P8258, The Engineer Office. P8258 B

AS CHIEF DRAUGHTSMAN or CHIEF DESIGNER, ADVERTISER (shop trained), 24 years' extensive experience, DESIRES CHANGE. All classes machinery. London or 50 miles radius.—Address, P8253, The Engineer Office. P8253 B

DRAUGHTSMAN, Young, REQUIRES POSITION under engineer ; 5½ years' D.O. experience in patents and instruments, technical education.—Address, P8242, The Engineer Office. P8242 B

PATTERNMAKER (42) SEEKS BERTH ; Thorough experience in high-class work, motor, marine, electrical, good foundry practice ; 8 years charge last berth.—Address, P8265, The Engineer Office. P8265 B

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Standardised Water Pipes and Fittings.

In the Journal for April 20th this year, we recorded the fact that the British Waterworks Association had submitted to the Ministry of Health a proposed specification for standard water pipes and fittings. With the Ministry's sanction it was intended to embody the specification in a model code of by-laws and regulations designed to be adopted, if thought fit, by any water undertaking in the country under statutory obligation to prevent the waste, undue consumption, misuse and contamination of its supply. Similar attempts to secure extended powers in connection with their consumers' pipes and fittings have been made by the water companies and boards since as far back as 1871, but they have all failed, and it is now intimated that the latest attempt has met a similar fate. While, however, the Ministry has refused to approve the Association's proposed code and specifications, the necessity for reconsidering the position in connection with the whole matter has been recognised by the appointment of a committee to advise the Minister from time to time regarding questions relating to the construction, standardisation and testing of water pipes and fittings, and to by-laws intended to prevent waste, &c. The committee held its first meeting last Friday. On it are representatives of the Waterworks Association, manufacturers of water fittings, users of water, sanitary authorities, and others. To meet the situation arising out of the past, and possible future, activities of the Waterworks Association in this matter, an association, to be known, probably, as the National Water Users' Association, is being formed among water pipe and fittings manufacturers, builders' merchants, architects, hot water engineers, and others. Meanwhile, it may be noted that so far as the London area is concerned, the only requirement affecting a consumer's choice of fittings is that contained in the Act of 1872, namely, that the fittings must be "sound, suitable and efficient."

The Nations' Armaments.

There is no more difficult task that can be essayed in the field of international relationships than the institution of a just comparison of the relative military strengths of a group of powers. For example, it is easy for an alarmist to attract public attention by stating, as has recently been done, that even with our new aeroplane squadrons in full being we shall still have only about one-third of the aerial strength possessed by the French. The comparison is fallacious, because it is made on the basis of squadrons in ignorance of, or neglecting, the fact that the British squadron contains a considerably greater number of aeroplanes than the French. Even in such an apparently simple matter as the relative strength of armies, the possibilities of going far astray are great, for the existence of a varying percentage of army service troops renders it necessary to count not heads but rifles. If we proceed to count rifles, we must also include pistols, automatic rifles and machine guns, and in the end we will fail to get a just comparison unless we can find some sound basis of bringing the whole to a common denominator, as, for instance, would be required for converting the number of machine guns into terms of equivalent rifles. The League of Nations has recently been conducting a statistical inquiry into the military strengths of the States composing it. Even, however, with the results of that inquiry before us we are still far from having a just picture of the relative strengths. We note, however, that in the matter of machine guns, the British Empire easily comes first with nearly 10,000, as compared with France's 7000, Italy's 2000, and Japan's 1000, but in light and heavy guns we are a bad fourth. In aeroplanes, the Empire's strength is given as 599 of all types, as compared with France's 1542. The most surprising item, however, is afforded under the heading "tanks," for while we have only 145, France possesses 1377. Even these figures, although they have been compiled by the League of Nations, leave the true position in the matter of national armaments open to question and doubt at many points.

London Tube Railway Developments.

The scheme for extending the London tube railway system into the south-west area, namely, the extension of the line from Clapham Common to Morden, near Wimbledon, will, it is intimated, involve an expenditure of some 6 million pounds and provide work for between 25,000 and 30,000 for a period of nearly two years. The work is to be begun next month, and it is hoped that the extension will be ready for opening by the middle of 1925, or eighteen months or so after its commencement. The line will have a total length of something over 5 miles, of which 4¼ miles will be in tunnel. For the construction of the twin tunnels electric rotary excavators are to be used, which, it is stated, will advance the work from 20ft. to 25ft. per day. There will be seven new stations on the extension, all of which, except the terminus at North Morden, will be underground. In the design of the six underground stations, a new feature will be adopted in connection with the escalators which, it is stated, will run all the way from the booking hall direct to the platforms and will permit a passenger to reach the platform level in a little over a minute after leaving the street. In addition to this new extension, it is proposed to begin almost at once upon the work of reconstructing and rebuilding the existing tube stations at Piccadilly-circus, Leicester-square and Waterloo.

New Light Cruisers.

The decision of the Government to begin work on several light cruisers as a measure for the relief of unemployment has created much interest in Barrow and on the Clyde, as these two shipbuilding districts were especially singled out in Mr. Baldwin's statement at Plymouth last Thursday, as having suffered most from the lack of work and as standing in particular need of assistance. The two new 35,000-ton capital ships are being built on the Tyne and at Birkenhead, but work upon them is being so badly held up by the boilermakers' dispute that they count at present for little in the way of employment. The Tyne, at any rate, is anxious to secure additional Government work. The member for South Newcastle has sought from the Admiralty an assurance that orders for some of the new cruisers would go to his constituency, but the First Lord, with commendable caution, has replied stating that "there is no objection to saying for the Tyne what the Prime Minister has said for the Clyde and Barrow." The new cruisers are intended to replace the "County" class—nine vessels of 9800 tons displacement, built between 1901 and 1903. As the Government Dockyards have also claims to consideration in the distribution of orders, it does not appear likely that any one district is likely to benefit considerably. The drawings of the ships, it is stated, are now being prepared, and it is hoped to award the contracts at about the New Year.

The Boilermakers' Dispute.

Justifiable surprise has been expressed at the spirit of procrastination revealed in the outcome of the national conference of the Boilermakers' Society, held at York on Tuesday and Wednesday of last week. As we recorded in last Friday's issue, the conference decided to submit definite proposals for the settlement of the dispute to the Trades Union Congress Mediation Committee. No information, however, was disclosed regarding the nature of the proposals referred to, nor has any such information since been given out. It is known now that at the conference the boilermakers' representatives had before them the recommendation of the Mediation Committee, that the dispute should be ended by the Boilermakers' Society's acceptance of the overtime and night-shift agreement in the same way as it had been accepted by all the other shipyard unions. That such a method of finishing the trouble has failed to commend itself to the boilermakers seems only too obvious. It appears that they still favour the submission of the dispute to arbitration, or the judgment of a court of inquiry, although, not only the Employers' Federation, but the Federation of Engineering and Shipbuilding Trades and the Trades Union Congress Mediation Committee, are opposed to, or, at least, do not endorse, such a proposal. A meeting to discuss the York proposals was called for yesterday in London by the Mediation Committee, and invitations to attend it were extended to the Federated Trades and the Boilermakers' Society, but at the moment of going to press we have no knowledge regarding the outcome.

Black Smoke from Locomotives.

On Monday, the London, Midland and Scottish Railway Company was fined two guineas, because, on September 13th, it permitted dense black smoke to issue, for a period of 3 minutes, from the chimney of a goods locomotive shunting on the railway between Eccles and Patricroft. The proceedings were instituted by the Health Department of the Eccles Corporation. It was contended by Mr. H. G. Shaw, locomotive superintendent, that the engine in question was provided with the best-known equipment for smoke consumption, while the company's assistant solicitor argued that the law did not expect that locomotives should be driven without making smoke. Nevertheless, the case went against the company as stated.

The Stourport Power Station.

Work, we learn, has now been begun on the erection of the Shropshire, Staffordshire and Worcestershire Electric Power Company's large new power station at Stourport. This station will contain, initially, from 12,500 to 15,000 kilowatts of generating plant, and is to form an essential feature of the scheme approved by the Electricity Commissioners for the re-organisation of electricity supply in the South-West Midlands District. Under the Trade Facilities Act, the Treasury has given a guarantee in respect of the capital sum of £700,000 required for the construction of the station. We learn that work has been begun on the foundations of the power-house building; that a contract for the supply of a 25,000 horse-power turbo-alternator has gone to Rugby; one for the supply of four large boilers to a Glasgow firm, and another for the condensing plant to Bradford. Two large rotary filters for the condensing water are to be made at Stroud, and the high-tension cable will be supplied by a Lancashire firm.

Locomotive Trade and Railway Amalgamations.

According to the managing director of one of the largest locomotive building firms in England, whose views on the subject were reported the other day in the *Journal of Commerce*, the locomotive building industry in this country is being badly hit by the railway amalgamations. Contracts, he said, had certainly been received recently from India, but even if the whole of the industry's overseas trade could be recovered, the private locomotive building works of this country would still be in a far from prosperous condition, for they could not dispense with the home market. The industry, he remarked, had now lost all the work that was formerly given to it by the smaller British railway companies that had no works of their own. The requirements of such companies were being met by the construction of engines in the works of the larger companies of the groups to which they belonged, and in some cases, in order to meet the increased demand, the railway companies' works would, apparently, have to be extended. He contended that there was no necessity to increase the country's locomotive manufacturing facilities, that the railway companies should perform only repair work, and that they should allow the private builders to construct their new engines. By so doing, he argued, not only would the industry be helped through the present troublous times, but the railway companies would derive considerable benefit from the traffic originating as a result of the industry's activity and would find that they could obtain their engines at a cost lower than that for which they could build them themselves.

The Still Engine.

It is understood that the marine type of Still engine, which Scott's Shipbuilding and Engineering Company, Limited, of Greenock, has built to the order of Alfred Holt and Co., has now been completed, and is about to undergo tests before the Marine Oil Engine Trials Committee of the Institutions of Mechanical Engineers and Naval Architects. The results of these tests, when published, will be studied with great interest by all engineers and shipowners.

Railway Shopmen's Bonus.

Ever since the beginning of the year the railway companies have been endeavouring to secure an agreed decision in the matter of the reduction of the railway shopmen's war bonus from 16s. 6d. to 10s., a reduction that would bring the railway craftsman's wages to the same level as those of the same trade and grade in ordinary engineering establishments. In their anxiety to reach an agreed decision so as to avoid being compelled to post notices of the reduction, the companies at one time modified their demand, proposing to reduce the bonus only by 3s. per week. When that offer was rejected, the demand for the full 6s. 6d. reduction was re-instated. The craft unions concerned and the National Union of Railway have maintained a stout opposition to the proposed reductions, the latter body at one time even threatening to call a general railway strike if they were enforced. Strong opposition, too, was expressed against submitting the dispute to arbitration, although subsequently this attitude was modified by the proposal to the companies that similar negotiating machinery should be established for the shopmen as existed for the other grades of railway workers. The companies have now replied to this suggestion, stating that such machinery cannot be made applicable to the shopmen, but adding that they are willing, as a means towards ending the deadlock, to refer the proposed reductions to a special court, established on the lines of the Wages Board or Industrial Court, with Sir William Mackenzie as chairman. The unions at the moment of going to press are engaged upon the consideration of this suggestion.

Locomotive Connecting-rods.

On Tuesday the Ministry of Transport issued a report by Major G. L. Hill regarding the circumstances of an engine failure which occurred on the London, Midland and Scottish Railway, near Crewe, on May 28th. When a Euston to Manchester passenger train was passing through Betley-road Station at a speed of between 65 and 70 miles an hour, the right-hand connecting-rod of one of the two engines drawing it broke and pierced the boiler and fire-box. The driver was severely scalded, but the fireman escaped injury. The report states that the railway company has decided that connecting-rods of express engines are to be examined every 10,000 miles, and that special instruction is to be given in the detection of flaws and fractures in such parts.

Science and Industry in America.

By WALTER ROSENHAIN, D.Sc., F.R.S.

No. VIII.*

TURNING from colleges and universities to great Government establishments and public institutions, two great military and naval establishments may at first be considered. These are the United States Arsenal at Watertown and the United States Navy Yard at Washington.

WATERTOWN ARSENAL.

The writer's acquaintance with Watertown Arsenal was, by force of time and circumstances, restricted to a visit to the laboratory of Dr. Langenberg and his associates, so that nothing can be said of the remainder of that great establishment. Watertown is situated within a few miles of Boston and Cambridge, Mass., and is thus naturally in close touch both with the Massachusetts Institute of Technology and with Harvard University. There appears to be fairly close co-operation between the scientific workers under Dr. Langenberg and those engaged in somewhat similar activities in the two institutions named.

The Arsenal Laboratory is devoted primarily to the mechanical testing of metals, and contains a very large variety of testing machines of different types. The most striking of them is the great Emery testing machine, a well known appliance of a very elaborate and costly kind, another example of which is to be found at the United States Bureau of Standards, Washington. This and other tensile testing machines need not be described in further detail, since they are well known to all engineers.

Of more specialised interest is an investigation which has been carried out at Watertown recently on the effect of low temperatures on the impact strength of steel. Results of these researches have now been published, showing the interesting result that the notched-bar impact figures fall off rapidly with temperatures below the freezing point, and that this falling off in impact strength may become serious when the neighbourhood of 0 deg. Fah. is approached. From the point of view of railway rails and similar material this is a matter of very much greater importance in America than in England, owing to the much lower temperatures occurring in the American winter. The results obtained at Watertown suggest that at least some American rail fractures may be due to the embrittling effect of great cold. For the aeroplane designer, however, this matter may prove to be of very considerable importance, not so much in regard to materials used in engine construction, since these will never be very cold when under heavy load, but in regard to the fuselage and general structural parts. For automobiles also, which may have to operate in cold climates, this matter may need careful consideration in connection with such things as chassis members, axles, springs, &c.

Another section of the Watertown Arsenal laboratories is devoted to the application of X-rays, in the first place to the examination of steel and aluminium alloy parts in order to detect internal flaws or cavities. An extremely powerful X-ray installation is provided, including tubes of the Coolidge type capable of working under a voltage of 200,000. This tube is supplied from a large high-tension transformer, and is used in a large specially constructed chamber heavily plated with solid lead. Appliances are provided for moving quite heavy pieces of steel into this chamber, and X-ray penetration of steel up to a thickness of 5in. has been accomplished. This, of course, requires prolonged exposures and the production of photographs. These are taken on large photographic films, and from two "view points"—*i.e.*, the relative position of tube and object is slightly changed for two successive photographs. The resulting shadow images are then viewed in a large Wheatstone stereoscope and a stereoscopic skiagram is produced in which cracks or cavities in the subject can be clearly seen and located. Whether this somewhat costly and cumbersome method can ever become of regular utility for inspection purposes seems doubtful, except perhaps for special castings or forgings of great importance. On the other hand, as a research method, capable of affording the founder in particular very valuable insight into the defects of his products, the installation of such appliances appears to be well worth while. The engineer is, in many cases, quite unaware of the degree of internal unsoundness to which castings, particularly, are frequently liable. When a failure occurs he is ready to blame an obviously defective casting, only to be met by the rejoinder from the founder that this particular casting is really better than a great many that are in use. The study of foundry products by X-ray methods has the great advantage that it can be applied to large numbers of castings without destroying them; it should therefore make it possible to study conditions of casting—including the question of design—on a scale not otherwise possible. In connection with shell forgings and other military material, some efforts in the direction of applying the X-rays have also been made at Woolwich Arsenal—this work, in fact, very largely parallels that at Watertown. The extension of such methods to wider fields yet awaits development.

Apart from what might be termed "heavy" X-ray work, a great deal is being done at Watertown in X-ray spectrometry, mainly concerning the inner structure of steel in various conditions. Reference has already been made to similar work which is being carried on in a number of American laboratories. At Watertown, as everywhere in America, the Hull photographic method and its developments are in exclusive use, the Bragg method, using the ionisation chamber, being ignored. While there are obvious advantages attached to both methods, it seems a pity that both are not used side by side, since neither is yet entirely infallible in its indications. At Watertown, however, the Hull method is being applied by means of a much larger "camera," giving a greater degree of dispersion in the resulting spectra. It is hoped, by this additional sensitivity to solve some of the more difficult outstanding questions in regard to steel, such as the true inner structure of iron carbide—cementite—and whether there really is or is not any difference between the lattices of iron above and below the A_2 critical point.

WASHINGTON NAVY YARD.

At the Washington Navy Yard, which is mainly concerned with the production and mounting of naval armament, exclusive of the actual production of the larger guns, the laboratories, although well equipped and staffed, do not represent so large a feature as they do at Watertown, their function being apparently much more narrowly confined to the control of materials, testing, &c., with very little provision for research. On the other hand, the manufacturing processes in use offer many points of very great interest. At almost the first glance, however, there is an obvious difference between the Navy Yard and the industrial plants of America; in the latter there is an obvious and predominating effort to secure mass production—"output" is the main object to which all else is more or less completely subsidiary. In naval work, in ordinary times, output is not one of the main objects, while in place of standardised designs which may, as in the case of the Ford motor, persist unchanged for ten or even fifteen years, the products must be kept, from year to year, up to the level of progress elsewhere. This difference naturally affects the whole organisation. Under war conditions, however, output became a seriously important factor—if not the vital factor—and new shops and organisations were set up. Thus at the Navy Yard there are several large and splendidly equipped shops—including a foundry—laid out for mass production in the best American style. Had the war lasted long enough, the stupendous output of these and hundreds of equally efficient output shops in America would have made itself felt. Indeed, the impression could not be resisted that, from the point of view of the production of munitions under stress of war, the American "output" methods would prove supremely effective. Provided that munitions could be kept effectively standardised, it would almost seem as if the American output alone, if pushed to a maximum effort, could probably outweigh the output of the rest of the world as at present organised.

This great plant at the Navy Yard is, naturally, to a very large extent idle, although efforts have been made to utilise the shops for other purposes. Thus the curiously-shaped iron letter-boxes which the United States Mail provides all over America are now being manufactured in thousands at the Navy Yard.

On the technical side one of the most interesting items of equipment are the gun-shrinking pits in which the outer jackets of guns are shrunk on the inner tubes. This process, as in many countries, entirely replaces the British method of wire winding; the grounds for the preference in America being mainly simplicity of construction and cheapness, combined with what is regarded as adequate quality in the product. The shrinking pits are very large and well arranged, the lighting being particularly good. The principal point of interest, however, is that the jackets are heated for shrinking on purposes by electric heaters. This makes a very compact and convenient arrangement and certainly saves an appreciable amount of labour in manipulation. It is, moreover, claimed that the temperature control is very much more accurate and that more constant results are obtained while the cost of heating electrically is actually less than by gas flames.

A large amount of interesting work is also being done at the Navy Yard in connection with the forging and heat treatment of nickel and nickel-chrome steels. The forging of large rings for gun mountings in a press that seemed much too small for the purpose is an example of considerable ingenuity. With regard to the steels used, the advantages of nickel-chrome from the point of view of the relative ease of heat treatment is fully recognised, but the difficulties that arose with this type of steel during the war have not been forgotten, and there is thus in America, as here, a certain prejudice against it for larger forgings. A simple nickel steel is preferred, but this, as is well known, has the disadvantage that, to bring about an equal degree of hardening, much more drastic methods of cooling are needed. Thus an oil quenching which will harden a nickel-chrome forging throughout will only affect the outer layers of a simple nickel steel. This difficulty can be overcome, according to the Washington Navy Yard, by the use of a special quenching medium which consists of an emulsion of oil and water, or rather of oil and a strong solution of a soapy substance in water. This solution requires to be retained in an emulsified condition by agitation, but provided this is done the quenching effect is practically equivalent to that of cold water, while there is no greater tendency to cause cracking or distortion than by quenching in oil.

McCOOK'S FIELD, DAYTON, OHIO.

This establishment ranks with Watertown and the Navy Yard, being in many respects the equivalent for the Air Force, although in America there is no separately controlled aerial arm. In many ways McCook's Field corresponds to our British Royal Aircraft Establishment at Farnborough, being very largely engaged in research, experimental construction and flying. In regard to the latter, the famous Wilbur Wright flying field is also situated close to Dayton, and intense interest in the breaking of speed-flying records which was in progress at the time of the writer's visit naturally extended to the Government establishment, the record breaking being actually accomplished by service pilots. At McCook's Field itself there is, naturally, a feeling of greatly reduced effort as the result of after-war conditions, but a considerable amount of research and experimental work is being carried on. It was interesting to notice, for instance, the very keen attention which was paid to the progress of British research work on light alloys. Undoubtedly some of the most advanced applications of these newer materials obtained by carefully controlled heat treatment is to be seen in some of the experimental engines at McCook's Field. Here again there is little or no published American research work to be drawn upon, but the results obtained in England are being eagerly utilised, while in England itself they are still being discussed as if they were merely matters of academic interest. One of the points upon which interest is being concentrated at McCook's Field is the development of the air-cooled engine. In view of the established success of certain air-cooled engines in American motor cars it is not unnatural that in the more favourable conditions of cooling presented in aeronautical work the possibilities of this type of motor should be further considered. If the developments in progress fulfil their promise the air-cooled engine for flying purposes will have to be seriously reckoned with, even for the larger types.

Interest also attaches to the work on the helicopter which is being done at McCook's Field. What has actually been achieved is a machine which the designer has several times flown, rising to a height of something like 8ft. or 10ft., and has then managed to land without damage. This is not, from the aircraft point of view, a very striking achievement, but for a helicopter it is a great deal. The machine itself is an unhandy looking construction of light alloy girders in the form of an equi-armed cross, each arm carrying a horizontal propeller. These propellers are driven by means of shafts from a central motor. The propellers look at first sight like great umbrellas. Actually their blades are constructed somewhat like aeroplane wings, covered with fabric. Their speed of rotation is, of course, low, and the pitch of the propeller can be varied by the pilot. This, in fact, is the method of control. If the machine, when in flight, inclines to one side a movement of the control lever increases the pitch of the propeller on that side and diminishes the pitch of the opposite one simultaneously. The result is a righting moment which generally overshoots the mark, so that the machine in flight rolls a great deal. Compared with the trim and effective aeroplanes in the adjacent sheds, the helicopter does not appear a promising type of aircraft, but it is not entirely safe to judge by appearances or obvious mechanical considerations; on those lines one might have criticised, if not condemned, the aeroplane itself in its earlier stages. There seems little doubt, therefore, of the wisdom of experiment and research in regard to helicopters, even if trained opinion is inclined to be almost more than sceptical.

One interesting point remains to be noticed in regard to McCook's Field, and that is its relation to the Bureau of Standards at Washington. There, as here, between the Royal Aircraft Establishment at Farnborough and the National Physical Laboratory, there is some degree of subdivision of aeronautical research and experimental work. The division there, however, appears to be more wisely arranged than it is with us. McCook's Field deals essentially with the large-scale work requiring a factory and a flying field rather than a laboratory. The Bureau of Standards deals with all such experimental work as can be done in a great laboratory, and deals particularly with the instruments used in aircraft. This clear-cut line of division successfully avoids all overlapping and friction.

PUBLIC INSTITUTIONS.

In addition to the Bureau of Standards, America possesses a number of important institutions devoted essentially to research, and no account of American science and industry in their mutual relations would

* No. VII. appeared October 26th.

be reasonably adequate without reference to at least some of them.

THE MELLON INSTITUTE.

The Mellon Institute at Pittsburg is of very special interest, since it was founded for the specific purpose of aiding the application of science to American industries. The foundation was made by the Mellon brothers, one of whom is, at the present time, Secretary to the United States Treasury. Dr. Weidlein, the enthusiastic director of the Institute, thus has the unusual advantage of being able to consult the living donor of the funds upon which the Institute is based, instead of being tied by the provisions of a will or trust deed. In its original form, the Institute provided facilities for research on industrial problems for firms wishing to utilise them, provided that the firm stating a problem for research paid the salary of one or more "Research Fellows." These "Fellows" work at the Institute and are afforded not only the full facilities which the buildings and equipment can provide, together with any special minor equipment that may be needed, but also the guidance and advice of experienced research workers like the director and his assistants who manage the affairs of the Institute. Under these conditions, the working cost of research and the general management charges of the Institute were borne by the foundation. Recently, however, Dr. Weidlein has come to the view that researches of this kind, conducted at the request and for the benefit of individual industrial firms, should be, at the least, self-supporting. The firms for which research is carried on are, therefore, now required to pay not only the actual salaries of their own research follows, but an additional "overhead" charge which covers the proportion of general expenditure entailed. It has not been found that the requests for research work at the Institute have been in any way diminished by this increase of charges, while, on the other hand, it leaves the Institute with funds for other purposes. It is particularly satisfactory to find that these funds are to be devoted to the prosecution of researches not suggested to the Institute by industry, but initiated within the Institute and directed towards the study of more fundamental problems than those usually investigated for direct industrial purposes. This recognition of the need of fundamental research as a background and source of stimulus for industrial research is very interesting; it serves to show how prolonged experience in such an institute, where industrial research is carried out under almost ideal conditions, has confirmed the view that such work of a wider and deeper nature is essential to the healthy life of a research institution, whether it be a public one like the Mellon Institute or directly attached to a particular industry.

Research on specific problems submitted by industries unavoidably entails the serious difficulty of secrecy. One consequence is seen in the arrangement of the laboratories at the Mellon Institute; these are arranged as a series of comparatively small rooms, so that the investigations on each problem can be segregated. This segregation, with its hampering restrictions upon the free intercourse and interchange of ideas and facts between workers on different problems, must be a serious hindrance to the work of the Institute. In a university, the aims of which are essentially educational, such an atmosphere would be intolerable—a fact which has been fully recognised in the wise opposition which has been shown in England to the continuance of secret researches in our universities. At the Mellon Institute the workers are advanced men, and they may be able to profit by mutual intercourse without "giving away" their secrets; none the less, the reserve implied must make things difficult. It certainly entails a great amount of separate apparatus in different rooms instead of the use of highly specialised but more or less "communal" apparatus.

One other difficulty arises from the need for industrial secrecy in regard to research results. If a particular field has once been taken up for investigation at the Mellon Institute by any individual firm, the Institute will not take up any other research in the same field for any other firm, not only while that research is still in progress, but for an indefinite time afterwards, unless the first firm specifically consents to research in that field being done for others. At first sight one would expect such a restriction to be a very serious matter, and one liable to abuse. In practice, Dr. Weidlein states most emphatically, it is proving no hindrance to the work of the Institute; the range of industrial fields is so wide that there is room for far more work than the Institute can undertake without recurring to fields already dealt with. Also, firms do not seem disposed to abandon the field of research upon which they have embarked, and frequently a series of research fellows are employed to continue research in a given field for a considerable number of years, the men passing into the direct service of the industry as the results of their work come to be translated into industrial practice. The Institute thus serves not only as a research laboratory for dealing with industrial problems, but also as a training ground for men who afterwards apply scientific methods and results within the industries themselves. There can be no doubt that the Institute thus renders most valuable service, and if this is supplemented, as is now to be the case, by more fundamental research work initiated by the Institute itself, that service will be increasingly effective. Actually, secrecy is not so universally insisted upon as might be imagined, and a considerable number of the researches conducted in the Mellon Insitute are more or less completely described in scientific and technical papers published by past or present Research Fellows. Dr. Weidlein points with pride to a very long list of publications, some of them of considerable importance.

The Motor Car Show at Olympia.

No. I.

THE great exhibition of motor vehicles which is held annually under the auspices of the Society of Motor Manufacturers and Traders, was opened to-day—Friday—at Olympia. Owing to the completion of the new annexe to the building, it has been possible this year to collect the whole of the exhibits under one roof. Compared with the exhibitions of former years, the Show which is now being held is, perhaps, the most remarkable for the exceptional value for money provided by most of the British car builders. Prices, generally, have fallen considerably since last year without any depreciation in quality. In fact, if the "accessories" which are now included as necessary to every car's equipment are taken into consideration, to-day's prices will compare favourably with those that were in force prior to the war.

There are not many radical departures from standard practice, but there are more small six-cylinder cars; there are more engines fitted with overhead valves, and spiral bevel gear wheels are more extensively adopted for the final transmission. The most pronounced feature of novelty in connection with 1924 models is the growing tendency to adopt four-wheel brakes. These may be broadly divided into two main systems. In one system, all four brakes are operated mechanically by a servo-motor device, which is brought into action by the driver, the advantage of which is that the driver is not called upon to exercise any muscular force. This system is expensive to install and somewhat complex, and is, therefore, not likely to become universal on the cheaper makes of cars. The second system, and that which promises to be the most popular, is an extension of the lever and link method applied in the usual way. With either system the employment of four-wheel brakes cannot fail to add to the complications, and past experience has demonstrated that unless the brakes are kept carefully adjusted, they may be a distinct source of danger. It is a much more difficult problem for the designer to tackle than that of a railway or tramway brake, for instance, owing to the steering movements of the front wheels and the torsional effect on the axle when the brakes are applied. Anyone who has had much experience of handling motor vehicles knows the uncomfortable sensation and danger caused when the rear brakes are not equally effective, especially on greasy road surfaces. He will be able to imagine what the result would be if a similar state of affairs existed in connection with front wheel brakes. Expert drivers can frequently rectify a skid brought about by the unequal action of the rear brakes by manipulating the steering; but this means of correcting a skid would not be available if the front wheel brakes are not acting in perfect unison. In writing thus, we are not seeking to disparage the adoption of four-wheel brakes, which are theoretically sound, but rather to warn the uninitiated that all four-wheel brake systems are not yet perfect, on account of the difficulties involved in their design and application—difficulties which will, no doubt, be surmounted in the course of time.

Another direction in which there is, apparently, an increasing tendency to depart from orthodoxy is in connection with transmission systems. The new ideas have for their object the extermination of the sliding gear-box, which the late M. Levassor, the inventor, described as "brutal, but it works." Briefly, there are three new systems, none of which can be said to be out of the experimental stage as yet. The de Lavaud system gives an infinitely variable gear in which the ratio is gradually lowered when the car is climbing a gradient, and is raised again on the level without any attention on the part of the driver. The essential features of this gear are a swash plate on the propeller shaft, to which a number of connecting-rods are attached at one end, their other ends being formed like one-way clutches, or free-wheel devices, which drive the axle shaft, the motion being derived from the wobbling movement of the swash plate. The automatic adjustment of the gear ratio is obtained by altering the angle of the swash plate. When the resistance is low, as on a level road, the stroke is long, or equivalent to a high gear. On the other hand, when climbing a hill, by shortening the stroke the gear is lowered. This variation of the stroke of the connecting-rods is brought about by a spring device which acts automatically on the swash plate cage.

A second new form of variable speed gear is, strictly speaking, only novel as regards the details of its construction. It consists essentially of an inverted toothed chain which runs on expanding sprocket wheels. The really novel feature of this gear, called the Healey, consists in the ingenious method of constructing the expanding sprocket wheels so that the tooth form is preserved whatever the diameter of the sprocket may be. The Constantinesco gear is another automatic variable gear system which is still in an experimental stage. By its adoption, the gear-box and clutch and final transmission gearing would be dispensed with. The car would always be in gear, and its movement would be controlled by the throttle. In the Constantinesco gear the engine transmits reciprocating motion to the axle by means of a crank, a beam and ratchet mechanism. The transverse beam, which is connected midway in its length to the crank shaft by a connecting-rod, is attached at one end to a pendulum and at the other to a forked ratchet gear on the back axle, or its equivalent. When the engine rotates a reciprocating motion is transmitted to the beam by the connecting-rod. This motion is, in turn, transmitted to the pendulum until the speed of the engine crank shaft exceeds that at which the pendulum will continue to swing, with the result that the two arms carrying the pawls are forced to move and oscillate, causing the axle to rotate. In this manner an infinitely variable transmission is provided. With certain modifications, whereby the pendulum and the ratchet mechanism can be eliminated, the Constantinesco gear seems to have great possibilities.

One of the most interesting exhibits amongst the more expensive cars is the new 21 horse-power six-cylinder Lanchester. In the design of this car the makers have introduced several original features,

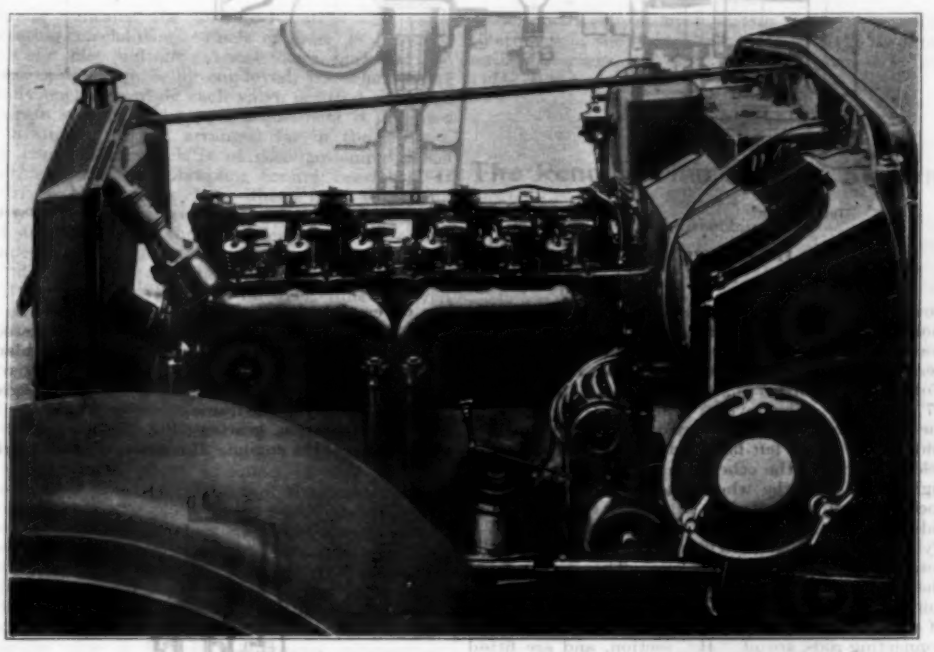


FIG. 1—ENGINE OF 21-H.P. SIX-CYLINDER LANCHESTER CAR

including four-wheel brakes of their own design and overhead valve mechanism. But to motor car engineers the most remarkable feature of the car is the adoption of the sliding gear-box. Hitherto, Messrs. Lanchester have only utilised epicyclic gearing for this purpose; in fact, this has always been an outstanding feature of their well-known car. An epicyclic gear with four gear ratios, such as the makers consider necessary for the comparatively low horse-power of the new car, was found to be out of the question on the ground of complication and weight. It was, therefore, decided to fit a four-speed sliding gear-box of special design. The gear ratios are:—Top, 4.375; third, 7.5; second, 10.5; and bottom, 17.521 to 1. The reverse gear wheels are only in mesh when in use, and they are operated by a separate sliding rod on the left-hand side of the box, the main selector rods for the other gears being carried on the right-hand side, the whole set being operated by a rocking shaft connected to a gate on the right-hand side. The engine dimensions are as follows:—Cylinder diameters, 74.5 mm.; stroke, 114 mm., the total capacity being 2982 c.cm. The engine is of the monobloc design, and the crank case is of aluminium. The crank shaft has eight journals, and is of large diameter hollowed out for lightness. The connecting-rods are of "H" section, and are fitted with white metal bearings carried directly in the steel, whilst the gudgeon pins are fixed in the small ends and have their bearings in the bosses of the aluminium alloy pistons. The pistons have three rings in the upper portion and a scraper ring at the bottom.

As above stated, the valve mechanism is of the overhead type, the inclined valves being operated from a central cam shaft by rocker arms, the latter having their fulcrums on the opposite side to the valves. Illustrations of the valve mechanism are given in Figs. 1 and 2. From these it will be seen that the fulcrums are carried in excentric bushes to allow for clearance adjustment. Midway in the length of the rocker arm is a recess for housing a roller, which bears on the underside of the cam shaft. This recess always maintains a supply of oil for lubricating the roller and cams. The other end of the rocker carries a pad which bears on a cap on the valve stem. To maintain uniform motion of the cam shaft, a special additional cam, against which a spring-loaded plunger makes contact, is provided for balancing purposes.

The lubrication of the engine is provided by means of a gear pump—Fig. 2—in the sump, and this delivers oil at high pressure into a filter, whence it is led to the main bearings of the crank shaft, to the big ends, to the overhead valve gear, to the timing gear, and to the spigot bearing of the clutch. The oil pressure is 45 lb. per square inch. The radiator provided is of the firm's standard design, and a thermostat is inserted in the pipe between the cylinder block and the radiator. The engine and gear-box are built up of a single unit, the crank case being split horizontally along the centre line of the bearings, and the fly-wheel pit is formed in the upper and lower halves. The engine is supported by four bearer arms in the side members of the main frame. An aluminium housing extends forward from the gear-box to bolt up to the fly-wheel pit, and the gear-box is supported on two bearer arms so that the complete unit has six supports. A toothed ring on the fly-wheel is provided for the starting motor, which is spigot-mounted into the bell-housing. The clutch consists of a steel plate of large diameter, which forms the driving member in conjunction with a claw-type universal joint. This plate is contained in a recess in the fly-wheel, on the outer side of which is a cover plate free to slide on pegs and held to its work by springs; frictional services are ferodal rings. The chassis frame bears a strong resemblance to that of the 40 horse-power Lanchester car, with its stiff tubular transverse members giving great torsional rigidity to the frame.

The distribution gearing—Fig. 2—is placed at the rear end of the engine. It consists of skew gearing mounted on the end of the crank shaft and steadied by an additional bearing in the crank case. This gear drives a vertical shaft, at the upper end of which is a further set of skew gearing, which drives the cam shaft, the latter being carried on pedestals cast with the cylinder head. A downward extension of the vertical shaft carries the main oil pump, which consists of two gear wheels of small diameter and wide teeth. The skew gearing of the crank shaft also operates a cross shaft, the right-hand end of which drives a centrifugal water pump with divided suction ports to reduce the end pressure and to prevent leakage through the pump's single bearing. The lighting dynamo is driven from the left-hand end of the cross shaft, and is spigoted in the crank case. A twin roller chain, operated by pinion on the same end as this cross shaft, drives the magneto. The rear axle is practically a replica of the 40 horse-power axle on a reduced scale, the axles being semi-floating with one large ball bearing mounted on the axle casing in the plane of the wheel track.

The suspension is by means of cantilever springs of the usual Lanchester type; the springs are made at the Birmingham works by an entirely new method. The leaves are ground all over on both sides, and between each leaf is inserted a strip of brass, an arrangement which gives extremely luxurious riding. No shackles are used, the ends of the springs being carried in trunnions which are housed in oil boxes. Finally, the springs are enclosed in leather gaiters. The front axle has been specially designed, and is of tubular construction, of large diameter to resist the torsional stresses imposed by the action of front wheel brakes. All the brake drums are of large diameter, those on the front wheels being actuated

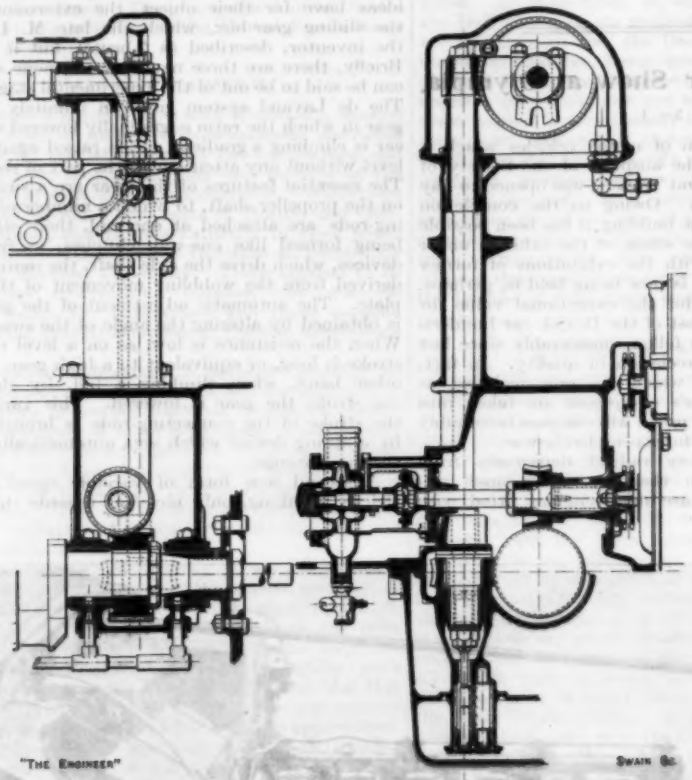


FIG. 2—VALVE MECHANISM OF LANCHESTER SIX-CYLINDER CAR

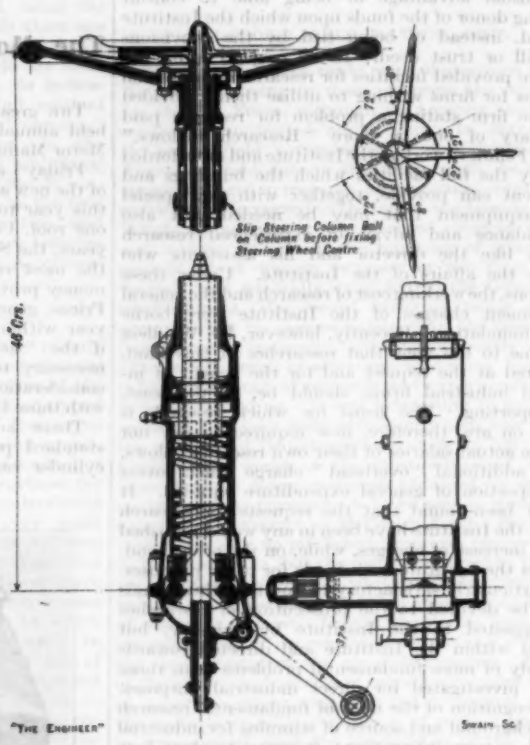


FIG. 3—STEERING WHEEL AND GEAR

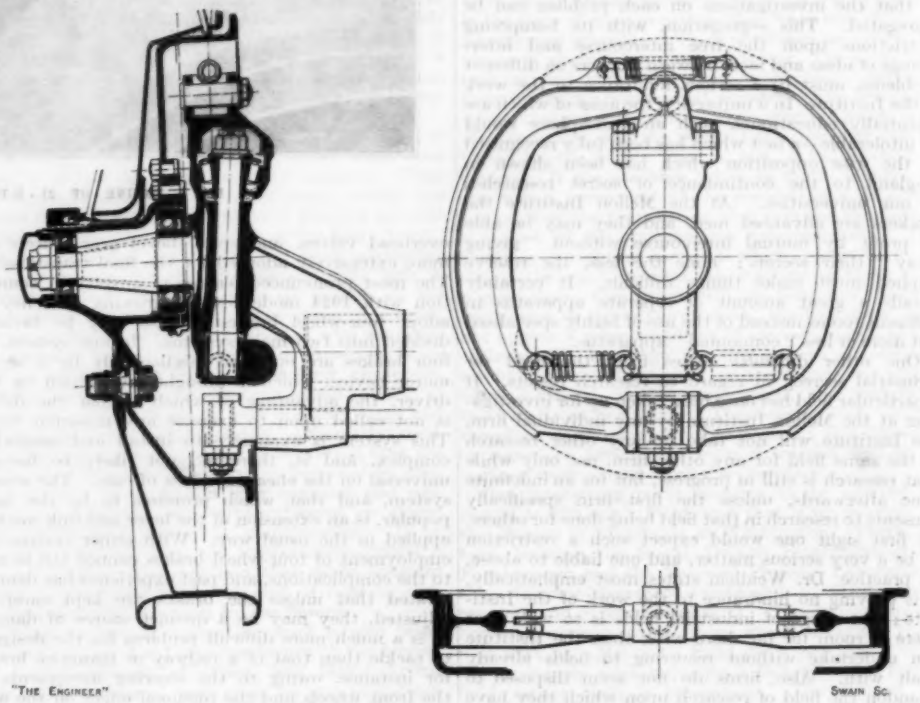


FIG. 4—FRONT WHEEL BRAKE OF LANCHESTER CAR

by universal cams beneath, and in actual alignment with, the steering pivots, as shown in the illustration, Fig. 4. No universal joints are required with this arrangement. Both front and rear brakes are operated simultaneously by the foot pedal, a compensation device being provided to ensure that each brake takes its proper share of the work. The hand brake operates on the rear wheels only by means of independent link mechanism. All adjustments to the brake gear can be made by hand without the employment of any tools. The arrangement of the front wheel brakes is ingenious. Below each axle end is a rocking shaft, having at its inner end a crescent-shaped lever to which the tie-rod is attached. Beneath the bracket forming the axle end is a lug, which forms a bearing for the rocking cam spindle. The spindle terminates in an eye, through which is passed a vertical pin which lies on the same centre line as the main swivel pin of the spindle head. A flat cam head at each end of the pin forces the brake shoes apart through the action of the cam. Across the front dumb irons is carried a divided rocking shaft, having a lever at each end linked up to the front brake cam lever, and on this divided shaft balance gear is provided for the front brakes. An operating tie-rod from the balance gear is carried to a bell crank on a swinging link below the pedal shaft, the other arm of the bell crank being linked to the pedal itself, whilst a third arm is connected by a tie-rod to a cross shaft carried in the frame bearing a compensating gear, from which the rod connections are taken to the levers of the back wheel brake cam shafts. In this way, compensating mechanism between the two rear brakes is provided. There is also an arrangement for balancing both sets of brakes.

The principle on which the steering gear is designed resembles that of the larger car, a right and left-hand thread on the spindle actuating two plungers which bear on rollers equidistant from the axis of the rocking trunnion—Fig. 3. All steering joints are of the self-aligning ball type.

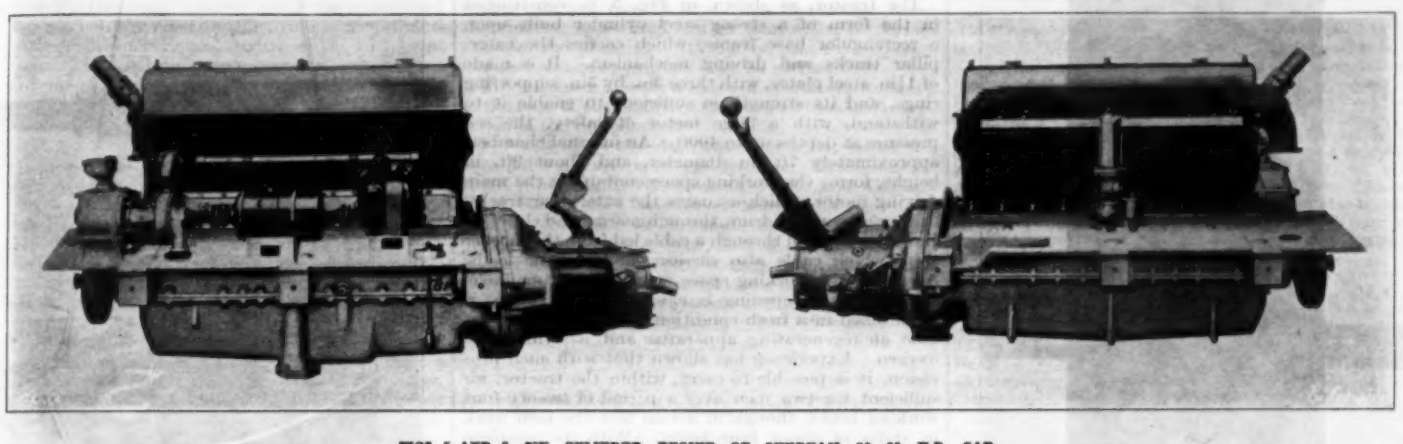
Reference to the electrical equipment should not be omitted. All the wires are carried in cast aluminium channels with detachable cover plates, and a substantial junction box is provided on the scuttle and under the bonnet. All connections to the dash-board instruments are accessible. Altogether, the new Lanchester car will be found to compare very favourably with the larger product of these works—than which no higher praise can be bestowed upon it.

In addition to its current models, the Sunbeam Motor Car Company, Limited, Wolverhampton, is showing a new 20–60 horse-power production of very clean and pleasing appearance. The engine of this new car has six cylinders—75 mm. bore by 120 mm. stroke and 3180.8 c.cm. capacity. The Treasury rating is 20.9 horse-power. Illustrations of the chassis and engine are given in Figs. 5, 6 and 7, and from these it will be observed that the engine, clutch and gear-box form a single unit suspended directly from the main frame. The crank case is of aluminium, and the upper half is cast to form a tray, which entirely surrounds the engine at the level of the frame, so as to ensure a perfectly clean engine. This tray also protects such parts as the water pump, dynamo, carburretter, &c., from grit liable to be thrown up from the road. The six cylinders are contained in a monobloc casting, and the detachable cylinder contains the overhead valves and valve operating mechanism. Each cylinder is provided with one inlet and one exhaust valve, push rod and rocker mechanism being employed, the whole being totally enclosed, while each valve is fitted with two separate springs, and tappet adjustment is provided by a simple method arranged for in the rockers. The cam shaft, which is of case-hardening nickel steel, runs in four phosphor bronze bearings. It is driven by a silent chain direct from the crank shaft. The pistons are of special aluminium alloy, and are fitted with three compression rings and a scraper ring at the base. The connecting-rods are of "H" section, and the crank shaft, which is a solid steel forging machined all over, runs in seven die-cast white metal bearings.

Oil is forced through the hollow crank shaft to all bearings by a gear wheel pump, which is driven by spiral gear from the cam shaft, and is arranged in the lower half of the crank case. An adjustable ball in the valve rockers fits into a cup at the end of the tappet rod, which is automatically fed with oil from the main service. Cooling is effected by means of a centrifugal pump mounted on the magneto drive shaft. The temperature of the water can be regulated by baffle plates fitted inside the radiator, while a thermostat enables the desired temperature necessary to be automatically maintained. The high-tension magneto, which is driven by a silent chain, is situated in a particularly accessible position. Fuel is fed by Autovac to the carburetter, the latter being of the latest Claudel Hobson type, and the induction pipe is heated to improve carburation. The starting motor housing is cast integral with the gear-box and the clutch casing. The dynamo, which is fitted on the near side of the crank case, is driven direct by silent chain from the water pump spindle. The clutch is of the single plate type, and has a fabric friction surface. The plate itself is made flexible, so as to give an easy and progressive pick-up.

The gear-box is bolted directly to the fly-wheel casing of the crank case, with which it forms a unit. Four speeds forward and reverse are provided, the gear wheels being of case-hardened nickel steel, all the shafts being furnished with ball bearings. The rear axle is of the semi-floating type, the casing being of pressed steel. The differential is of the bevel type, and the final drive is by spiral bevel crown wheel and pinion, all the shafts having ball bearings.

The brake equipment comprises internal expanding fabric-faced shoes, which operate on large steel drums on the front and rear wheels. The brakes on all four wheels are operated simultaneously by pressure on the pedal. The hand brake lever operates the brakes on the rear wheels only. All the brakes can be adjusted. Semi-elliptic springs are fitted in the front, and full cantilever springs at the rear. The steering is of the worm and sector pattern, mounted on ball bearings, and an eccentric adjustment is provided to compensate for wear.



FIGS. 5 AND 6—SIX-CYLINDER ENGINE OF SUNBEAM 20-60 H.P. CAR

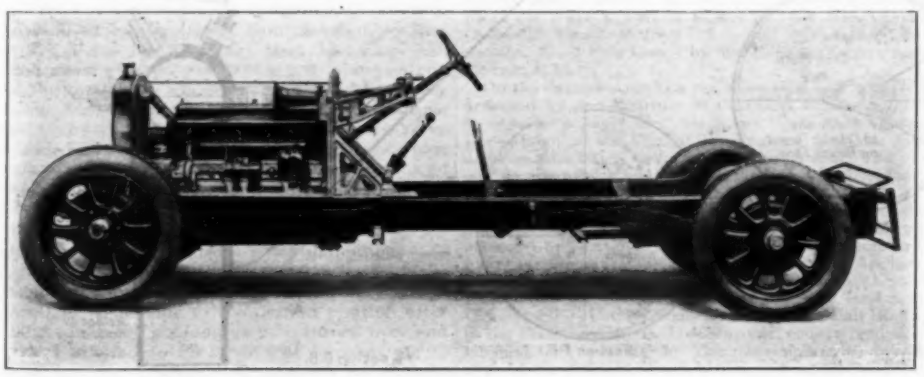


FIG. 7—CHASSIS OF 20-60 H.P. SIX-CYLINDER SUNBEAM CAR

The Reno Marine Salvage System.

IMPORTANT and far-reaching developments in submarine salvage practice are foreshadowed by the new method of raising sunken ships which forms the subject of the present article and to-day's Supplement. The system we are about to describe was invented by Mr. Jesse W. Reno, a consulting engineer of New York, who is well known as the inventor of the escalator. He has perfected the details of the apparatus in such a manner that within recent months a 500-ton steel vessel, lying in 60ft. of water at the bottom of Long Island Sound, New York, has been raised, and following the success of this demonstration test it is expected that at no distant date a large and extensive salvage operation will be undertaken off the British coast.

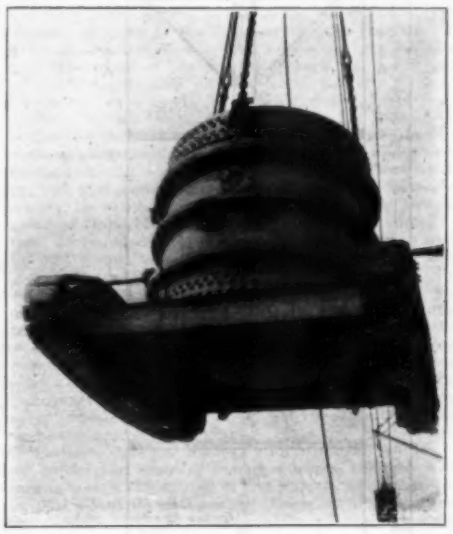


FIG. 1—LOWERING THE TRACTOR

The outstanding features of the Reno method of raising ships are the use of a submarine tractor for drilling holes into the sides of the hull, and the employment of vertical open-ended pontoons, which are pulled down by a winding drum on the tractor and are, therefore, independent of surface disturbance arising from waves or movement of the mother ship. These pontoons, when submerged and filled with air, lift the ship by means of hooks inserted into holes drilled by the tractor. Before giving a detailed account of the machinery and pontoons employed, the steps taken to raise the steamship Scally from its heeled-over position on the bed of Long Island Sound, may be recounted.

The coastguard cutter Scally, illustrated in our

Supplement, was originally one of the "Eagle" gunboats, and had an overall length of 200ft., a breadth of 25ft. and 18ft. moulded depth, with a loaded displacement of some 500 tons and a net submerged weight of about 260 tons.

After her period of service with the Coastguard Authorities was completed, she was being towed

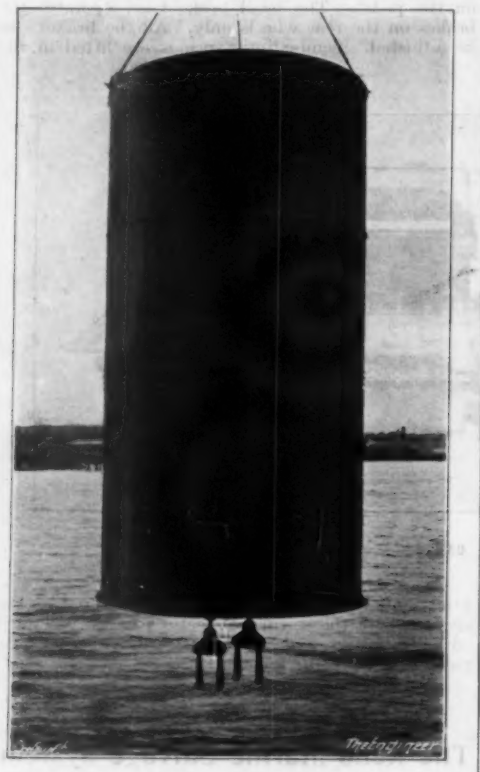


FIG. 2—PONTOON WITH LIFTING HOOKS

away for breaking up when, owing to the taking in of unequal water ballast, she capsized in Long Island Sound and settled down on her side in about 60ft. of water. The task of raising her was undertaken by the Reno Marine Salvage Corporation, with a view to testing the Reno system, and demonstrating its practicability. Operations were conducted from an ordinary derrick lighter, which served the purpose of a mother ship, and which, in our first Supplement illustration, is shown with the tractor and one pontoon on board. For future work a special mother ship, provided with a well to receive the tractor and enable it to be lowered through the ship, will be used. A preliminary operation was that of righting the ship. It was done by attaching two pontoons to the port-holes of the foremost and after deck-houses by wire rope slings fastened to their lower sides. Then, by displacing with compressed air the water in the pontoon, sufficient leverage and lifting power was obtained to place the ship on an even keel and so enable the further operations to be continued. These, for the main part, involved the drilling of thirty-two holes in the sides of the ship, and attaching the lifting hooks of the eight pontoons which were used. This part of the process will be more clearly understood by referring to the illustrations given in Figs. 6, 7 and 8, we reproduce on page 478.

The tractor, as shown in Fig. 5, is constructed in the form of a strong steel cylinder built upon a rectangular base frame, which carries the caterpillar tracks and driving mechanism. It is made of 1¼in. steel plates, with three 3in. by 5in. supporting rings, and its strength is sufficient to enable it to withstand, with a large factor of safety, the sea pressure at depths up to 400ft. An internal chamber, approximately 7ft. in diameter, and about 9ft. in height, forms the working space containing the main driving motor, which actuates the caterpillar tracks, drills, and winding drum, through gearing and clutches. Power is supplied through a cable led from the mother ship, which cable also carries the telephone leads. Access to the working space is given by a manhole, and when this opening is closed the air supply is maintained in a fresh condition by means of a soda-lime air-regenerating apparatus and a cylinder of oxygen. Experience has shown that with such provision, it is possible to carry, within the tractor, air sufficient for two men over a period of twenty-four working hours, though in actual fact the men work in shifts of about four hours. With its complete equipment the tractor weighs about 18 tons, from which must be subtracted a displacement equal to nearly 10 tons, leaving a net weight of 8 tons for the tractor in position on the sea bottom. For purposes of lowering, a stout triple chain sling, attached to cleats on the top supporting ring, is used. The illustration, Fig. 1, shows the operation of lowering the tractor into position, and the construction of the underneath part of the tractor. A nearer view of one of the twin drills is given in Fig. 6, from which it will be seen that the drilling bar takes the form of thick shaft passing through water-tight stuffing-boxes fitted to either side of the tractor shell, and capable of considerable movement in a lateral direction. The drill itself consists of a centring drill of about 1¼in. in diameter, which is followed up by a reamer of conical shape, enlarging the hole to 5in. diameter. The recent developments in oxy-electric under-water cutting may lead, eventually, to a burning method being used whereby, instead of drilling, a circle of metal will be cut out of the plate.

In designing the tractor care was taken so to arrange the propelling tracks that they move very slowly and are capable of independent motion, giving an easy and accurate control of position. It has been found that there is no difficulty in spacing the holes when drilling under water, and that the drill may be manipulated to within less than 1in. of the desired centres. The illustration which we reproduce in Fig. 8 shows four of the holes drilled into the hull of the Scally under water, and serves to indicate the exactness of the spacing. The slight deformation in shape was caused by the pull of the lifting hooks on the ⅞in. shell plate above the bilge keel. In clear water a certain amount of light is available for working

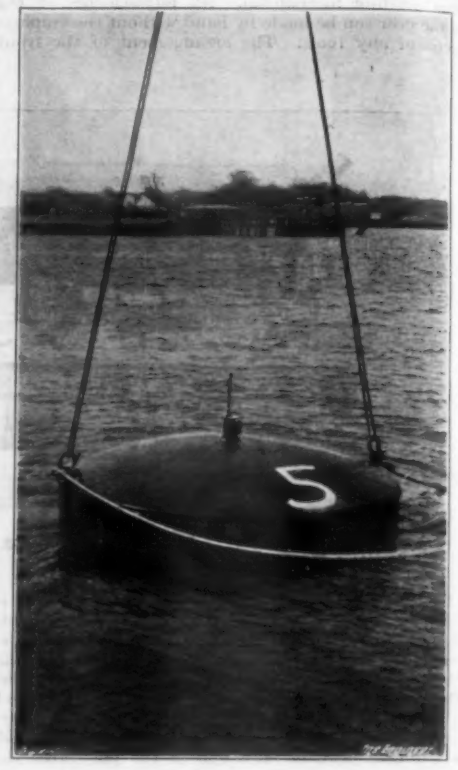


FIG. 4—PONTOON FLOATING IN VERTICAL POSITION

in depths up to over 60ft. of water, but auxiliary lighting is furnished by four powerful illuminating lamps placed on the outside of the tractor, so that the work in hand may be flooded with light.

After the holes have been drilled the next operation is to place in position the hooks suspended from the pontoon—see Fig. 2. As the hooks and slings have together a total weight of about 2 tons, some convenient means of controlling their position from within the tractor had to be devised. A neat mechanical appliance was developed, which is illustrated in Fig. 7. At right angles to the drilling bars are two further stuffing-boxes in the tractor shell, through

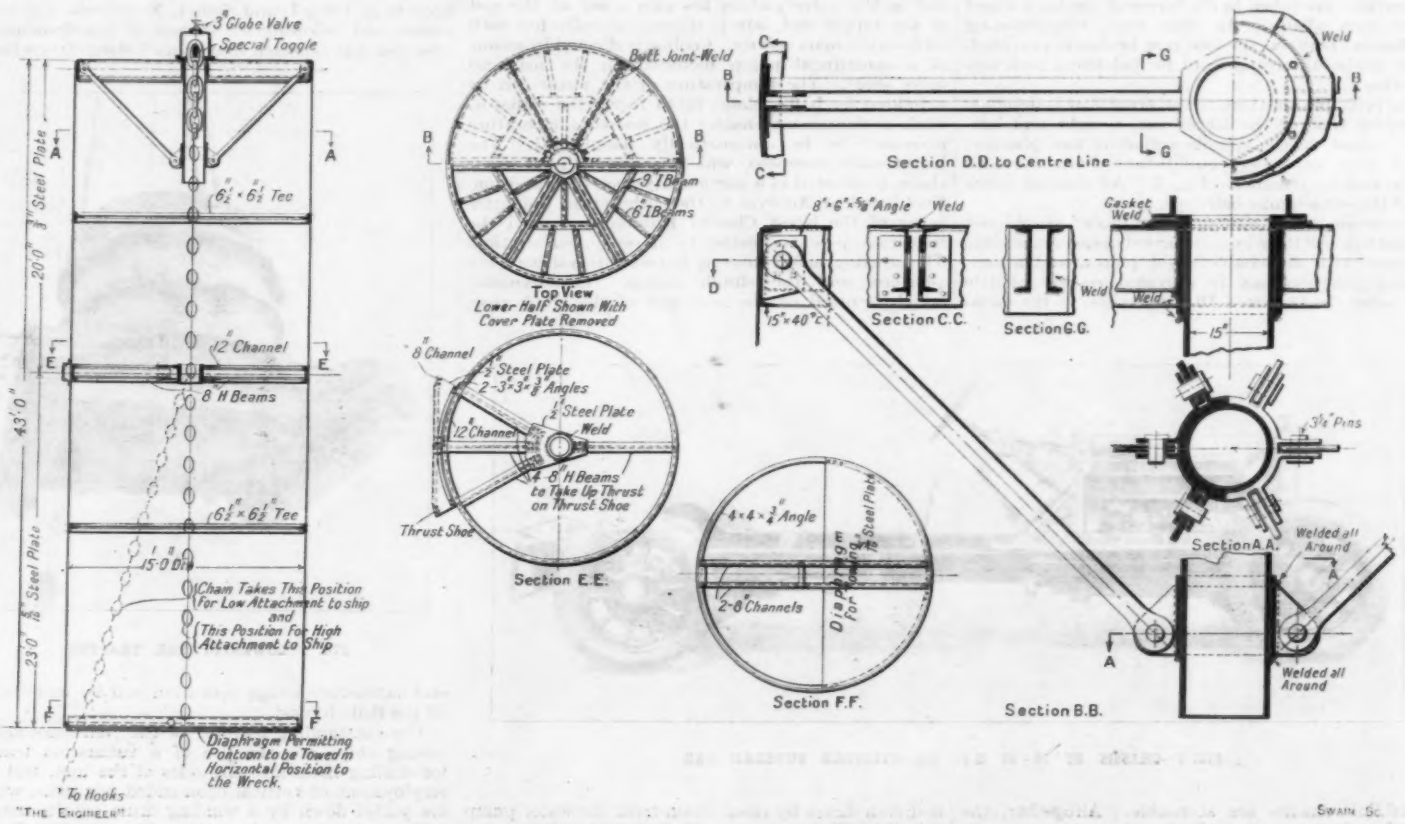


FIG. 3—CONSTRUCTIONAL DETAILS OF A 200-TON LIFTING PONTOON

which project two T-headed directing bars capable of being moved like the drills in a lateral direction. On each bar one of the arms is furnished with a short projecting piece at right angles to the tee head, so that when the bars are rotated the horizontal position of the hooks can be altered. The vertical height is adjusted by the winding drum ropes attached to the pontoon, and so by hand manipulation the hooks may be placed in the holes drilled to receive them. In this way it will be seen that the ½in. points of the hooks can be moved in three dimensions into the 5in. holes. Referring to Fig. 5, it will be noted that at the front of the tractor is a large winding drum actuated by the main tractor motor through bevel gearing. When the rope on this drum is unwound a buoy attached to the end of it rises to the surface of the water. One of the floating pontoons is then brought up to the buoy and a dog on the buoy is passed over the end of a tee bar guide welded down the side of the pontoon. The signal having been transmitted to the tractor that the buoy is attached to the pontoon, the drum is rotated and the buoy and the dog then slide down until a stop is reached and the pontoon is drawn down to the required position for attaching the hooks to the hull. As soon as this is done the drum is again unwound and the buoy again rises to the surface ready for the next pontoon. The figures 5, 6 and 7, on page 478, show the carrying out, on test plates, of the operations we have described, but under water the same tasks were quickly completed once the procedure had become familiar. Altogether thirty-two holes were drilled in the Scally, and as the holes are bored in pairs, this corresponded to sixteen different positions of the tractor. We are informed that while the first pair took nearly a day to complete, the last set was put through in less than three hours. Similarly in placing the hooks, it was only after one or two unsuccessful attempts occupying practically the whole of one day, that the hooks of the first pontoon were attached. On the other hand, the last pontoon was put in its place in twenty minutes.

As shown by the first illustration of our Supplement the weather was particularly severe when operations were begun, and the presence of melting snow and ice in the water added to the difficulties, especially in the matter of clear vision.

Although four pontoons would have furnished ample lifting power to raise the sunken hull, it was decided to utilise eight half-filled pontoons in order, as far as possible, to distribute the lifting stresses over all parts of the structure. This precaution was necessary on account of the extreme thinness of the shell plating, which was only $^{3}/_{16}$in., with the exception of the ½in. plate above the bilge keel, to which we have already referred. During the preliminary operations, before the vessel was righted, some of the hooks which were pulling on the single plating at a wide angle tore through it when the pontoons were filled with air, with the result that the pontoons shot upwards through the water and over 25ft. into the air. It was observed that where the holes were made through the double plating the hooks held fast and there was no distortion even although the pull exceeded 70 tons.

Tensile tests made on specimen plates at Columbia University where the actual hooks for placing in the holes were used to stress the plates, showed that with a ¾ plate a load of 30 tons was readily sustained. In practice thicker shell plates will have to be dealt with and the stresses will be kept at 25 tons. The illustrations reproduced in Figs. 2 and 3 show one of the pontoons ready for lowering, and also one within about a foot of its natural floating position. The dimensions of pontoons used on the Scally were: diameter, 12ft.; length, 25ft.; lifting capacity when filled with air, 70 tons; buoyancy when floating free, 2 tons. The method of constructing the pontoons allows them to be built of comparatively thin material, so that they are light for transport and handling. An internal truss riveted and welded to the pontoon forms the support to which the chains and hooks are attached, and by means of which the load is transmitted to the whole pontoon. At the top a globe-valve is provided for the supply of air and the supply pipe extends about 4ft. down into the pontoon, so that an air lock sufficient to allow the pontoon to float in a vertical position is formed even when the supply valve is opened.

Attention may be called to the diaphragm—see Fig. 3—which half closes the bottom end of the pontoon. It provides a means of towing the pontoon horizontally on its side to the desired position, after reaching which the pontoon may be turned over and the water allowed to fill it so that it takes up its vertical floating position. A pontoon of slightly modified design is shown in Fig. 3, and the details of construction are given. It will be noted that in this case the internal truss is placed in the head, and a strengthening ring with a thrust shoe is formed lower down, about the position of the centre of buoyancy. The two positions of the chain hooks when pulling straight and also sideways are indicated. This pontoon was designed for a lifting capacity of about 200 tons, and it has an overall length of 45ft., with an internal diameter of 15ft. One great advantage is obtained by using open-ended pontoons, namely, that when filling with air either from a top valve or from beneath by air hose and nozzle fitting, the pontoon is shown to be full by its "spilling." Furthermore, as the ship rises and the air in the pontoon expands, it is automatically discharged from the open bottom, and no excess of pressure is accumulated. In actual practice once the pontoons are attached to the hull and hooked to it, they are filled with air in symmetrical pairs so as to distribute the lifting pull equally over the hull. The actual balance of lifting power required to make the vessel rise from the bed is supplied by four pilot pontoons, placed two forward and two aft. This method reduces the number of pipe connections which have to be made to the compressed air plant of the mother ship, and incidentally it provides a means of controlling the height the vessel is lifted, so that in bad weather the hull may be kept below the surface waves and currents and towed to a position where divers can work on the plugging of the holes, and the ordinary surface salvage operations may be carried out.

The sequence of such a series of operations is shown in the case of the Scally in the views which are reproduced in the Supplement.

The raising of the ship was carried out under the personal supervision of its inventor, Mr. Jesse W. Reno, Commander G. Bowles, R.N., and Captain J. M. Cappelen. The Reno Marine Salvage Corporation has now a London office at Trafalgar-buildings, 1, Charing Cross, S.W. 1, and the task of salving some of the many vessels sunk around the coasts of Great Britain and France during the war is at present engaging its attention.

Public Works, Roads and Transport Congress.

THE programme of the Public Works, Roads and Transport Congress, which is to be held in the Agricultural Hall, London, concurrently with an Exhibition dealing with the same subjects, from November 22nd to 29th, has now been published.

On Thursday, November 22nd, at 11 a.m., there will be two conferences arranged by the Association of Managers of Sewage Disposal Works, when the following papers will be discussed:—(1) "Rivers Pollution," by Mr. C. Jepson, the resident chemist at the Davyhulme sewage works of the Manchester Corporation; and (2) "Sewage Works Analyses and Standards of Purification: a Plea for Greater Uniformity," by Mr. J. H. Garner, the manager of the Huddersfield sewage works. The chairman will be Mr. Joseph Garfield, M. Inst. C.E., sewage works manager, Bradford. In the afternoon of the same day, at 2.30 p.m., there will be two further conferences arranged by the same Association, at which the papers to be considered are:—(3) "Sludge Digestion," by Mr. John D. Watson, M. Inst. C.E., engineer to the Birmingham, Tame and Rea District Drainage Board; and (4) Sludge Disposal," by Mr. John Haworth, general manager of the sewage disposal works of, and chemist to, the Sheffield Corporation. The chairman will be Mr. I. G. Gibbon, assistant secretary, Ministry of Health.

On the Friday morning, at 11 o'clock, there is to be first of all a general meeting of the British Waterworks Association, which will be followed by a discussion of a paper entitled: (5) "The Revision of Legislation in Regard to Water Supply," by Mr. A. R. Atkey, the chairman of the Water Committee, Nottingham, and Past-president of the British Waterworks Association. The chairman on this occasion is to be Mr. Charles H. Bird, President of the Association and chairman of the Cardiff Corporation Waterworks Committee. During the afternoon session of the same conference, which will be under the same chairmanship, the following papers are to be taken:—(6) "Relation of Compensation Water to Stream Flow," by Mr. F. W. Macaulay, M. Inst. C.E., the chief engineer of the City of Birmingham Water Department; (7) "Welsh Water," by Mr. George R. Collinson, M. Inst. C.E., water engineer and manager to the Swansea Corporation; and (8) "Various Aspects of the Cardiff Waterworks Undertaking":—(*a*) "The Wenallt Storage Reservoir," by Mr. Neil J. Peters, M. Inst. C.E., deputy water engineer; (*b*) "The Llwyn-on Reservoir," by Mr. H. W. B. Cotterill, Assoc. M. Inst. C.E.; and "The Taff Fawr Section, No. 2 Pipe Line," by Mr. B. Santo Crimp, Assoc. M. Inst. C.E.

On the Saturday, at 11 a.m., there is to be a conference arranged by the Institute of Cleansing Superintendents, to consider a paper on "Transport Work in the Salvage Department of the City of Birmingham," by Mr. James Jackson, the city's cleansing superintendent. The chair will be taken by Mr. Alexander Findlay, the President of the Institute.

On Monday, November 26th, there are to be no meetings in the morning, but at 2.30 p.m. there are to be conferences arranged by the County Land Agents' Association on the following papers:—(10) "Market Gardening as Applied to County Council Small Holdings: and How to Assist the Small Holder," by Mr. E. W. Hill, county land agent, Worcestershire County Council; and (11) "Small Holdings in the Fens," by Mr. E. J. A. Christie, county land agent, Holland County Council. The meeting will be presided over by Sir Francis Floud, K.C.B., permanent secretary, Ministry of Agriculture and Fisheries.

On the Tuesday, at 11 a.m., there are to be conferences arranged by the Associations of Local Authorities, in conjunction with the County Surveyors' Society, on:—(12) "General Construction of Bridges," by Lieut.-Colonel J. F. Hawkins, M. Inst. C.E., county surveyor of Berkshire, and Captain C. G. Mitchell, Assoc. M. Inst. C.E., of the Ministry of Transport; and (13) "Reconstruction of Foundations of, and Carpets on, Existing Roads," by Mr. W. P. Robinson, Assoc. M. Inst. C.E., surveyor to the Surrey County Council. Sir Henry P. Maybury, K.C.M.G., Director-General of Roads, Ministry of Transport, will take the chair.

At the afternoon conferences, which have been arranged by the Institution of Municipal and County Engineers, the following papers will be presented:—(14) "Estate Road and Private Street Construction and Standardisation," by Mr. E. Willis, M. Inst. C.E., engineer and surveyor, Chiswick; and (15) "The Latest Types and Use of Mechanical Appliances in Connection with Road Maintenance and Construction," by Mr. Norman Scorgie, M. Inst. C.E., borough engineer and surveyor, Hackney. The chairman will be Mr. W. T. Lancashire, M. Inst. C.E., city engineer, Leeds, and President of the Institution.

On the Wednesay morning, at 11 a.m., the Institute of Public Administration will hold a conference on a paper entitled "Some Notes on the Organisation and Equipment of an Accounting Department," by Mr. A. T. V. Robinson, Controller of Cost Accounts, War Office. Sir Harry Haward, Vice-chairman, Electricity Commission, will preside. In the afternoon conferences will be held under the auspices of the Institution of Gas Engineers, when consideration will be given to two papers, the first being:—(17) "Quality and Composition of Town's Gas," by Mr. Harold E. Bloor, engineer, secretary and manager to the York Gas Company; and (18) "The Position of Mains in Public Highways," by Mr. Stephen Lacey, Assoc. M. Inst. C.E., distributing engineer to the Gas Light and Coke Company. The President of the Institution, Mr. S. Tagg, engineer and manager to the Preston Gas Company, will take the chair. Concurrently a conference arranged by the Incorporated Municipal Electrical Association will discuss a paper entitled (19) "Electric Strays," which will be presented by Mr. Charles Raphael, M.I.E.E. The chairman is to be Mr. S. E. Britton, President of the Association and electrical engineer to the Chester Corporation.

On Thursday, November 29th, both morning and afternoon conferences will be under the direction of the Institution of Municipal and County Engineers. The morning session will be devoted to the following papers:—(20) "Changes in Road Construction and Maintenance," by Mr. Harold Collins, Assoc. M. Inst. C.E., borough engineer and surveyor, Colchester; and (21) "Road Foundation and Carpeting: a Review," by Mr. Ernest Worrall, M. Inst. C.E., surveyor, Stretford. In the afternoon, at 2.30 p.m., the following papers will be taken:—(22) "The Evolution of the Road and Transport Thereon," by Mr. F. Marsden, city engineer and surveyor, Bradford; and (23) "The Road Beautiful," by Mr. J. L. Redfern, borough engineer and surveyor, Gillingham. The chairman for the whole day will be Mr. W. T. Lancashire.

SIXTY YEARS AGO.

IN our issue of October 30th, 1863, we reprinted the presidential address delivered by Mr. Wm. H. Maw before the Civil and Mechanical Engineers' Society. In a footnote it was stated that the author was "of the Great Eastern Railway Works, Stratford." In 1866 it may perhaps be added, he became joint editor of our contemporary, *Engineering*, a post which he continues to hold. In his address Mr. Maw gave a very interesting and enlightening account of the progress made in engineering science during the preceding year. . . . Tucked away in an odd corner of the same issue was a short paragraph recording no less than five railway mishaps, any one of which, had it happened nowadays, would have attracted considerable attention. In one case a London and North-Western express, going at full speed, was "dragged off the rails" in consequence of one of the carriage tires bursting. On the same evening a North London train met with a mishap as the result of a wheel breaking off from an axle. The other accidents comprised a derailment and two collisions. In none of the five was any one injured. In addition, we learn from a leading article in the same issue that in the course of the preceding week the boiler of a large goods locomotive on the North-Eastern Railway had exploded as a result, or so we deduced, of internal corrosion. In this connection we wrote that locomotive boilers in this country exploded only upon those lines the locomotive superintendents of which refused to adopt the hydraulic test. . . In a paragraph entitled "The Federal Navy," we find a quotation from the *New York Journal of Commerce*, in which the relative strengths of the British, French and United States Navies were given as follows:—Britain, 16 ironclads, 341 steam vessels; France, 16 ironclads, 325 steam vessels; United States, 54 ironclads, 323 steam vessels. Commenting on these figures, the *Boston Commercial Bulletin* said that in spite of the apparent strength of the American navy, the United States were utterly unable "to capture the British pirates or blockade the Southern ports." In explanation, it stated that the majority of the United States war vessels were merely merchant steamers equipped for war purposes. Their gunboats were little better than failures, while of the ironclads all but three were not seagoing boats, and of the monitors none was fit for other than harbour defence duties. But that it would be theirs before the close of the century to dispute with Britannia herself the empire of the sea was as clear to the mind of the *Bulletin* writer as anything in the future, no matter what might be the outcome of the Southern rebellion.

THE Ministry of Industry and Commerce in the Irish Free State has appointed Mr. Thomas M. Batchen, M. Inst. C.E., who was the Engineer of the Irish Board of Works, to be an Inspecting Officer of Railways under Mr. J. J. Ingram, the Assistant Secretary for Transport in the Ministry. There has recently been issued the report by Mr. Batchen on the derailment on April 24th on Bray Head—mentioned in our pages on May 4th—which showed that the Dublin and South-Eastern Railway there is well watched against falls of rock, and that the many concrete side walls showed that great care was being exercised. Mr. Batchen added, however, that it was not clear that the same attention was given to the portion of the cliff outside the company's property, and he recommended that the company should periodically examine the whole of the cliff face. If the company had not the right to do so, the company should acquire such right in the interest of the safety of its trains.

The History and Progress of Metallurgical Science.*

By SIR ROBERT HADFIELD.

SECTION I.—INTRODUCTION.

War Work.—In my Lectures since the War I have always considered it desirable to make reference to the Great War from which we emerged victorious, thanks not only to the superhuman efforts of those in our Island Home, but also by reason of the magnificent service rendered by our Commonwealths, Dominions, India, and other outlying parts of the Empire. Though in peace time we did not always appear to pull together, we spoke with one united voice when the Empire was attacked.

Sometimes it would seem as though the lessons of the War were already fading from our memories; but surely the iron entered into our souls too deeply ever to be forgotten. We may generously want to forgive our enemies, who started the strife with all its attendant horrors, but we must never allow the memories of those terrible times to depart from us.

In the help that was rendered, the manufacturing and industrial centres of this country nobly did their utmost. In my own city, Sheffield, we did our best to help the nation in her hour of need, and we know that Birmingham did so too. A short time ago I asked Sir Graham Greene, who during the War was Secretary to the Admiralty, then Secretary to the Ministry of Munitions, and who now has charge of the War Records, what was Birmingham's share in the War. He replied that your city was one of the most important centres for the supply of war material and munitions, most of its work being carried out by private contractors and not directly through the Munitions Board or National Factories. He also stated that in addition to the large output of Projectiles, Small Arms, Ammunition, and other similar products, Birmingham was responsible for one National Shell Factory, one National Gauge Factory, and two National Rifle Factories. The total output from the National Shell Factory was many millions of shell, components including copper driving bands, gauges, trench mortar ammunition, brass and copper tubing, steel hammers, ammunition boxes, and hundreds of other products.

The Birmingham Board of Management rendered great help, for which the men at the front must indeed have been thankful. Your city, too, was largely responsible for those prehistoric-looking productions known as "Tanks," which gave such magnificent service in the field.

Ancient and Modern Artillery.—Whilst for nearly three hundred years Birmingham has not directly felt the hand of war, in 1643, when besieged and taken by Prince Rupert, history tells us much destruction of life and property was then caused. I suppose the artillery of the attacking force at that time was scarcely up to the standard of that used by our Empire in the Great War. Had Prince Rupert been here this evening I would have asked him to allow me to make a comparison for a few moments between his artillery, throwing cannon balls weighing a few pounds, and our modern guns, which throw monster projectiles weighing thousands of pounds each.

You will doubtless be interested in the following figures which give an idea of the high velocities and enormous energies developed in modern guns of small, medium, and large calibres. The energy developed by guns can conveniently be compared with the energy of a Rolls-Royce car. At a speed of, say, 60 miles per hour the Rolls-Royce car possesses an energy of 337 foot-tons. The Armour Piercing projectile from a 4¼in. 50-calibre gun, fired at 1100 foot-seconds velocity, leaves the gun in possession of the same energy, namely, 337 foot-tons. With this energy the Hadfield Projectile in question perforates unbroken a hard-faced armour plate 3in. in thickness, placed 100ft. from the gun. The motor car has a bulk of about 450 cubic feet as compared with 0.082 cubic feet for the Projectile, yet this object of such small mass has stored in it as much energy as the large motor car travelling at 60 miles per hour.

For permission by the War Office and Admiralty to take the cinematograph pictures of loading and firing a 15in. gun, which I am showing you this evening, I am indebted to Colonel B. R. Kirwan, C.B., C.M.G., Director of Artillery, and Captain J. O. W. Henley, R.N., Director of Naval Ordnance. I also have pleasure in acknowledging the help so freely rendered by Colonel D. Clapham, D.S.O., Superintendent of Experiments at Shoeburyness, assisted by Commander R. F. P. Maton, R.N., Experimental Officer. This 15in. gun weighs 97 tons, has a length of 45 calibres—that is, 57ft.—and the projectile with its cap weighs 1910 lb. At its full elevation and with a muzzle velocity of 2500 foot-seconds the range is 20 miles. Figs. 1 to 4 represent photographs, probably the first ever obtained, from a camera placed within 50ft. of the impact of a large calibre projectile striking with more than 60,000 foot-tons of energy against an armour plate.

The largest naval gun yet constructed has a calibre of 18in.—a calibre, by the way, now prohibited as a result of the Washington Conference. The Armour Piercing projectiles for this gun, weighing 1½ ton each, were made by my firm during the Great War, and were capable of accomplishing the following feat. The gun weighs about 150 tons, and when elevated to 45 deg. is able to carry its capped projectile weighing 3320 lb. loaded ready for firing for a distance of something like 50,000 yards, or, in round figures, about 30 miles.

I witnessed the first round fired from this gun at a hard-faced armour plate. The projectile, when capped and striking normally, is capable of perforating armour of the following thicknesses, the projectile itself remaining unbroken and carrying its bursting charge through the plate. At point-blank range a thickness of no less than 41in. of hard-faced armour is perforated, which is equivalent to a wall of unhardened steel of about 4½ft. At 10 miles and 20 miles respectively, 22in. and 12½in. of hard-faced armour of the latest and best type are perforated. Finally, at the extreme range of no less than 30 miles the projectile passes intact through nearly 1ft. of ordinary steel armour.

In actual trials projectiles from this gun perforated hard-faced plates of a thickness nearly equal to the calibre of the gun, and this at an angle of 20 deg., at a velocity equivalent to a range of about 9 miles. Thus the heaviest armour afloat, when attacked by an 18in. gun, would not appear to be, metaphorically speaking, much better than cardboard.

The difficulty of hardening an Armour Piercing Projectile of these dimensions will be readily understood, for in the case of an 18in. projectile a volume of something like 10,000 cubic inches of steel, heated to a temperature of about 900 deg. Cent., has to be quenched suddenly in a cold bath of oil or other medium. The effect of this treatment is to convert material which has originally, when cold, a Brinell ball hardness of only about 200, to one of hardness between 600 and 700. To deal with the strains set up by the sudden change from material which is almost plastic to one of extreme rigidity is indeed a difficult problem, as can be well imagined when it is stated that steel of this rigidity readily scratches glass. In addition, it must be borne in mind that the rupture strains which are set up by the sudden cooling may continue, not for hours, but for days, weeks, or even months afterwards. However, my firm was able to solve the problem satisfactorily, and supplied considerable numbers of these large Projectiles to our Navy. I do not remember a single one ever having been found cracked in store or on shipboard.

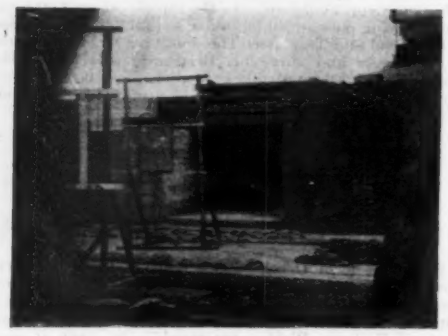


FIG. 1—VIEW OF BUTT

FIG. 2—ONE-SIXTEENTH SECOND LATER. IMPACT ON PLATE

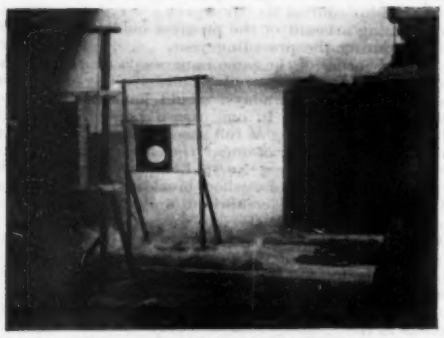


FIG. 3—ONE-EIGHTH SECOND LATER THAN FIG. 2

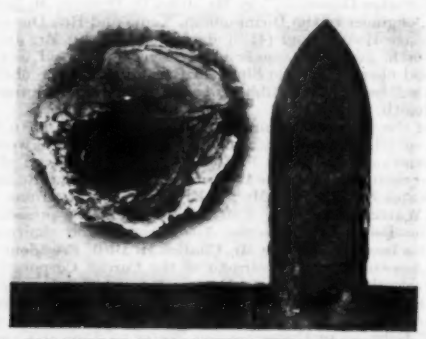


FIG. 4—THE UNBROKEN PROJECTILE, WEIGHING NEARLY ONE TON, AFTER PERFORATING THE THICK ARMOUR PLATE

These figures represent three remarkable photographs showing the impact effect of one of the Hadfield armour-piercing projectiles, weighing nearly one ton, fired at high velocity against thick hard-faced armour. Whilst the speed of the camera was too low to record the actual effect on the plate, it will be observed that the hole in the screen cardboard and the flash caused by the impact on the surface of the plate, all occurring in about one-seventieth part of a second, have been successfully obtained. It is probable that nothing of the same nature has ever before been shown, specially in view of the fact that the striking energy was very high, more than 60,000 foot-tons. The fourth photograph shows the Hadfield large calibre projectile recovered unbroken and the hole which it has made in perforating successfully the thick hard-faced armour-plate.

SECTION II.—THE CITY OF BIRMINGHAM AND ITS HISTORY.

Under Charles II. Birmingham advanced rapidly and its "manufacture of fire-arms became considerable." In 1692 the town obtained its first Government contract, and "Steel Houses" (Steel House-lane) were started about 1700.

From the earliest times iron was smelted in or near Birmingham—as was quite natural, seeing that all the necessary materials, iron ore, coal and limestone, were available practically on the spot. Hence, there grew up in the neighbourhood small works where the crude iron produced in the furnaces was converted into articles of general utility. These works were apparently no more than smiths' forges, and small crude foundries, their production including simple tools for the use of husbandmen and tradesmen, nails and chains, and later, as the craftsmen became more skilled, hardware and probably such implements of warfare as were then in use, also body armour.

This period may be assumed to represent the industrial activities of Birmingham down to the beginning of the sixteenth century, when Leland found in 1540: "Many smithes in the towne that use to make knives and all manner of cutting tooles, and many lorimers that make bittes and a great many naylors, so that a great part of the towne is maintayned by smithes." William Camden, who visited the town in 1586, noticed "a nest of smithes." In 1627 a book was published at Oxford which mentioned "Bremincham" as being inhabited by blacksmiths and forging sundry kinds of iron utensils.

In 1700 the first thread of cotton spun without the aid of human fingers was produced in a small building about 6 miles from Birmingham, whilst in 1741 the invention had made further progress, and yarn was spun by an engine turned by two asses walking round an axis in a large warehouse in the Upper Priory at Birmingham. This city therefore might have become a Cottonopolis.

Staffordshire without doubt has been one of the chief pioneers in the smelting of Iron Ore. In 1686 it practically supplied the whole country, and since 1740 the output of pig iron in the Midland area has been equal to about half the total output of Great Britain.

The work of Dud Dudley should not be forgotten, for he was the inventor and pioneer of that system of manufacturing cast iron which has helped to make the Midlands great. His life is referred to more fully later on. In 1718 Darby revived Dudley's invention, which had remained in abeyance for over thirty years after his death. Highly skilled moulders' work was carried out at Coalbrookdale about 1710 and onwards, showing that cast iron could be made, producing not only useful but artistic specimens of the decorative art, such as fire-backs and slabs, which are prized all over the world.

Matthew Boulton, the son of a Birmingham manufacturer, established the Soho Works, and it was here that Watt worked. The necessity for the use of Watt's Engine was rendered still greater by the adoption in Staffordshire, in 1784, of Cort's puddling invention, which made it necessary to raise more fuel. James Watt made cast iron mixtures containing steely iron, thus producing in 1760 what is now called semi-steel. A fuller reference to the work of Watt and others is given later in this Address.

In 1750, so busy were the "smiths and founders" of Birmingham, that they petitioned Parliament to allow pig iron to be imported free from our American Colonies to keep them going. Between 1769 and 1804 there appears to have been a large number of patents taken out by Midland ironfounders for making malleable cast iron, and it is curious to find that Matthew's patent of 1783 contains the germ of the

* An address delivered before the Birmingham University Metallurgical Society on Tuesday, October 30th, 1923. Abridged.

Black Heart process now employed so successfully in America. In 1782 occurred the first use by foundrymen of the invention of Wedgwood, the Midland potter, for the more accurate measurement of high temperatures; this was used for over 100 years before the present pyrometer was brought out. The beginning of the nineteenth century saw a great impetus in the application of cast iron for constructional purposes, and we have the first cast iron bridge of any size erected in 1785 at Coalbrookdale, on the Severn, where it is still in use. In 1794, Wilkinson, of Sheffield, took out a patent for a Cupola, the lines of which are practically the same as in use to-day, and 1800 saw Cupola melting taken up in the Midlands and the country generally. Metal patterns appear to have been adopted by local founders about 1810, although their use in other parts of the country was probably earlier.

In a paper on "The Iron Industry of South Staffordshire," read by Mr. Daniel Jones, F.G.S., at the Iron and Steel Institute meeting in Birmingham, 1895, he describes a sight which will probably never be seen again. He mentions that when travelling from Birmingham to Liverpool on a dark night, about the year 1854, he was surrounded by a wild and brilliant scene. The country was apparently in uncontrolled flames; tongues of fire from 150 blast-furnaces licked the sky, for the economist had not yet completed the utilisation of waste gases. Two thousand puddling furnaces sent forth their flames, whilst hundreds of mill furnaces, cupolas, air furnaces, and other flame generators, also thousands of pit fires dotted over the country, illuminated the scene.

FIG. 5—MONUMENT TO DUD DUDLEY IN ST. HELEN'S CHURCH, WORCESTER

Past Great Men in Birmingham and District.

Prominent Men of the Past.—In describing briefly some of the great men of the past who have helped to make the City of Birmingham what she is to-day, and to render her famous in the annals of our Empire, I need offer no excuse for this retrospect, for is not a correct conception of the living past a guide and help to us of to-day? It is the past which has helped to make the present what it is. Even so far back as B.C. 300 the Philosopher Publius Syrus said: "Each present day is the scholar of yesterday." It is useful, therefore, for the younger men growing up amongst us to study the history and character of those men of the past to whom we are so greatly indebted. They represent men of thought and action who struggled long and strenuously in their day and generation to advance knowledge. Feeble as may seem the knowledge existing in those earlier times compared with ours of to-day, do not let us forget that it was these earlier workers who fanned the flame of inquiring minds. Let us remember, too, that "from small beginnings great things spring." It is hoped that the portraits, which in certain cases accompany the descriptive matter, may lend an added interest to those reading this Address. The names selected from those workers of the past associated with Birmingham are mainly connected with the development of the following branches of science:—*Engineering*—Savery, Boulton, Watt, Murdoch, Siemens; *Metallurgy*—Dud Dudley, Gore, Percy, Greenwood; *Chemistry*—Priestley; *Electricity*—Kapp. There are others, too, who might have been mentioned, but want of space forbids. Sir Oliver Lodge, although no longer in Birmingham, is happily still with us; I do not therefore refer to his great work here, as this is dealt with later, when describing the prominent men of the present day.

Dud Dudley (1599–1684).—Let us now turn to the work of one who was closely connected with practical metallurgy, namely, Dud Dudley, who was born in 1599 about 8 miles outside Birmingham. In 1620 he erected his furnaces at Bradley, 9 miles away from the city. The world owes to him the method of smelting iron by means of coke converted from "pit-coale," instead of by charcoal as formerly used. But for his invention the manufacture of cast iron on its present immense scale would have been impossible. He took a prominent part in the Civil War as a Royalist, and was a Colonel in the Army of Charles I., and General of Ordnance to Prince Maurice. In 1642 he was engaged in making cast iron cannon at his foundries for the Royalist troops.

Dudley, in collaboration with Simon Sturtevant and John Rovenzon, wrote in 1665 his book on the manufacture of iron, *Metallum Martis*, or "Iron made with Pit-Coale and Sea-Coale." He spoke of this country being able to supply "His Sacred Majestie's other Territories with Iron and Iron Wares and Steel also, by Iron and Steel made with Pit-coale, Sea-coale, and Peat; and thereby be helpful unto themselves and England and all Plantations of His Majestie's, on this side and beyond the line." As showing the ignorance and mystery prevailing at the time regarding Metallurgy even such a pioneer as Dudley says, with reference to iron manufacture: "I might here speak somewhat of Superior Planets producing Metal; Saturn, Lead; Jupiter, Tin; and Mars, Iron." This was evidently before the days of spectrum analysis! It was also Dud Dudley who obtained a quaint acknowledgment of his service to Captain John Copley regarding the manufacture of iron. It runs as follows under date December 30th, 1656: "Memorandum—The day and year above written, I, John Copley, of London, Gentleman, Do acknowledge that after the Expense of diverse Hundred Pounds to Engineers, for the making of my Bellows to blow, for the making of Iron with Pit-coale or Sea-coale near Bristow, and near the Forrest of Kings-wood; that Dud Dudley, Esq. did perform the blowing of the said Bellows at the Works or Pit above said; a very feisible and plausible way, that one man may blow them with pleasure the space of an hour or two; and this I do acknowledge to be performed with a very small charge, and without any money paid to him for the same invention."

In the church of St. Helen's, Worcester, there is a large monument to Dud Dudley fixed on the south wall in two columns; this is shown in the accompanying Fig. 5. I am indebted to Colonel E. H. Nicholson, of Newark, for the following translation of the inscription on the monument:—

Dust and Shadow—Smoke.

Dust thou art and unto dust shalt thou return. Gen iii. 19.

For we are but of yesterday and know nothing; because our days on earth are a shadow. Job viii. 9.

Dodo.

Dodo Dudley, Commander of 1000 men. Son of Edward, late Lord Dudley, dear to his Father, a most loyal subject and servant of the Royal House, a useful vassal of the Court, a champion of the Church, and a stanch upholder of English Liberty and Law. Often captured in the year 1648, once sentenced to death and yet not beheaded. He lived as an old man, ever of unshaken virtue, to see the crown reborn again (*i.e.*, the Restoration).

The longest life but puts off death and does not banish it.

But it is a matter of much concern whether one dies to-day or to-morrow.

Mai 1630
F.H. A.F. D.D.
F.A. I.E. I.V.
E.S.

It is inevitable, therefore one shuns it, yet it is not to be dreaded.

Here lies

Elianore, wife of the aforesaid Dud Dudley. Daughter of Francis Heaton (by Mary his wife, daughter of Francis Dingley of Charlton) son of Francis Heaton and grandson of George Heaton, lord of the manor of Winkell in Lincolnshire, who married Joan, one of the coheirs of Sir Robert Byfield (the rest married to Byron Molyneaux and Sir Miles Bushley). William Heaton his grandfather married Sir George Merry's daughter, of An Bright in Lincolnshire. She was born 1601, the 25th of December, at 6 of the clock, 4 Ser. P.M. pol. 52.24. died 1675, Decemb. 3, at 3 of the clock.

O my beloved pilgrim this is the lot of me, thy wife to-day,

To-morrow my husband, it will be thine.

Death treads on all our heels, Thou canst not escape it.

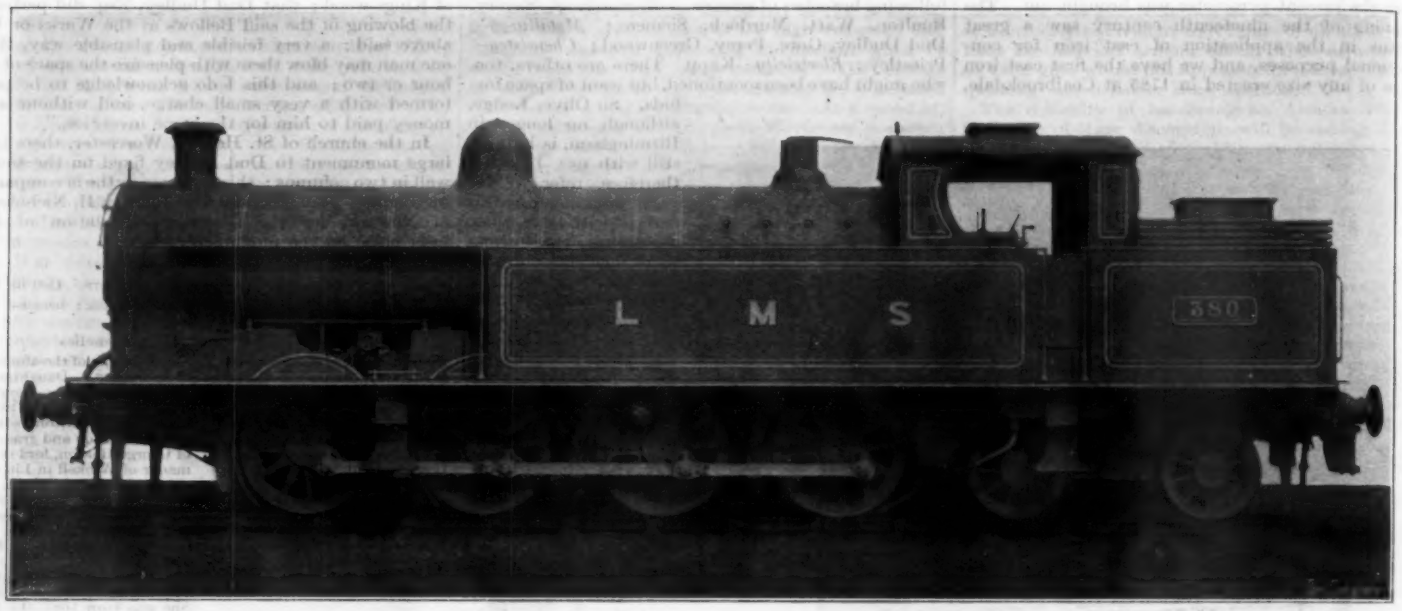
Though spent my breath, I still will hope.

Let us now survey the work of six of the early investigators in the district who helped to develop Steam Engineering.

FIG. 6—DENIS PAPIN, F.R.S. (1647–1714)

Papin (1647–1714).—So far back as about A.D. 50, Hero of Alexandria is credited with the earliest

LONDON, MIDLAND AND SCOTTISH RAILWAY—NEW EIGHT-COUPLED TANK ENGINE



known employment of steam as a motive agent, but the next step of any importance does not appear to have been taken until 1700 years later, when Papin, of French origin, studied the subject of steam power. It is in no spirit of depreciation of Watt's great discovery and invention, which are referred to later, that attention is called to the work of Professor Dionysius Papin, M.D. (1647–1714), Fellow, and at one time Secretary of the Royal Society, whose portrait is shown in Fig. 6. Whilst he was not connected with Birmingham, a reference to the development of the use of steam as a motive power would certainly be incomplete without his investigations being mentioned. In 1681 he published a paper on "A New Digester for Engines," and later, in 1690, a paper in the *Acta Eruditorum Lipsiæ* entitled "A New Method of obtaining very great Moving Powers at Small Cost." On these papers are based Papin's claims to be considered one of the early originators of the steam engine. Papin availed himself of the apparatus of Otto Guericke and worked out the important fact that if a closed cylinder were filled with steam and the steam then allowed to condense, a vacuum would be formed within the cylinder, and that consequently a movable piston fitted to the interior of the cylinder would then fall under the pressure of the atmosphere.

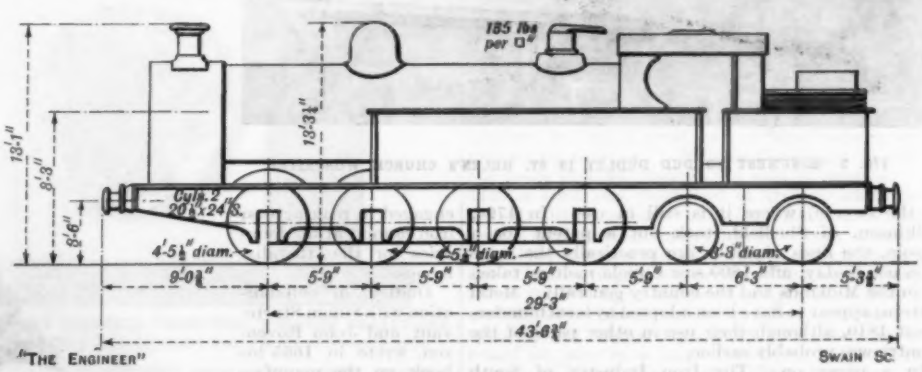
About the middle of the 17th century the important discovery had been made that the atmosphere was a fluid possessed of weight, the pressure due to which could be excluded at will from the interior of a closed vessel so as to obtain a vacuum; this was the foundation of the development of the steam engine. In Papin's experiment there was some suggestion of the principle of Newcomen's engine, but the proposal was abandoned by him.

Previous to this he had made an unsuccessful attempt to obtain a vacuum by the explosion of gunpowder in the small cylinder beneath the piston, a description being published in September, 1688, in the *Acta Eruditorum Lipsiæ*. It is possible that Papin may have had his attention drawn to the subject by reading a book published in London in 1651 by an unknown Author, entitled *Invention of Engines of Motion lately brought to perfection whereby may be despatched any work now done in England or elsewhere (specially works that require strength and swiftness), either by wind, water, cattel, or men, and that with better accommodation and more profit than by anything hitherto known or used.*

Although Papin overlooked the difficulties of applying power to various mechanical processes, he was best known in England on account of his Digester, described by him in the paper previously mentioned. His works are rare and it is doubtful whether more than a single copy of the Memoir of 1690 is in existence. The fact that Papin was at one time Secretary of the Royal Society shows that he must have been a man of considerable knowledge. Papin described in 1707 an inferior sort of steam engine, in the preface to a little work entitled *Nouvelle manière d'élever l'eau par la force du feu*, printed at Cassel. Besides showing the power of steam by the famous experiment of his Digester, he proposed in a pamphlet printed in 1695 the construction of a new pump, the pistons of which were to be moved by the steam of boiling water. Whilst Papin's early work is fully admitted, as a well-known French writer at the time said: "It is a great thing even to suggest this idea, but it remained to realise and execute it in a simple and convenient manner. The English, referring chiefly to Watt, are the first who have succeeded in that."

Savery and Newcomen (1608–1729).—In 1698 Thomas Savery patented and constructed what was known as the "fire engine." It is possible that he was indebted to the Marquis of Worcester. In any case, however, it may be safely said that he was the first to utilise fuel as a practical means of performing mechanical work. Then came Newcomen (1663–1729), assisted by John Cawley, both of Dartmouth, who, following in Papin's steps, succeeded prior to 1712 in perfecting the atmospheric engine, from which the growth of the modern steam engine can be clearly traced. Later on Newcomen and Savery seem to have come to an understanding with each other regarding their patents. Their type of engine remained for upwards of sixty years for draining mines; in fact, down to 1789 nearly 100 engines had been built for the northern districts, and about half that number for Cornwall.

(To be continued.)



PROFILE OF LONDON, MIDLAND AND SCOTTISH RAILWAY NEW TANK ENGINE

L.M. and S. Rly.—Eight-Coupled Tank Engine.

A NEW series of 8-coupled tank engines has recently been put into service by the London, Midland and Scottish Railway Company. The engines, which are illustrated in the accompanying engravings, were designed at Crewe in 1921, and are of the same pattern as, but larger than, the 0–8–2 side tank shunters built in 1911. Their outstanding features are that they have, as compared with the older engines, increased coal carrying and tank capacity and enlarged axle-boxes, slide-bars and hornblocks; that they are furnished with superheaters; and that all the journals are lubricated by a mechanical pump and the cylinders by a displacement lubricator. The new engines are also fitted with a special design of reversing gear which enables either wheel or lever to be used at will. The valves are actuated by "Joy" gear.

The coupled driving wheels, which are arranged at 5ft. 9in. centres, are 4ft. 5½in. in diameter. The bogie wheels, which are at 6ft. 3in. centres, are 3ft. 3in. in diameter. The total wheel base is 29ft. 3in. and the rigid wheel base 17ft. 3in. The cylinders are 20½in. in diameter by 24in. stroke, and the working pressure is 185 lb. per square inch. Further particulars are as follows:—

Total heating surface	2046.0 square feet.
Grate area	23.6 square feet.
Water capacity	2030 gallons.
Coal capacity	3.5 tons.
Weight, empty	69 tons.
Weight, in working order	88 tons.
Maximum tractive force—	
At 80 per cent. boiler pressure	28,711 lb.
At 85 per cent. boiler pressure	30,506 lb.

With the engine in working order the leading pair of wheels take 16¼ tons, the second pair 18½ tons, the third pair 16½ tons, and the trailing pair 15¼ tons. Each of the bogie wheels takes 10¼ tons.

The engines are being built for mineral and local passenger working on the heavy gradients in South Wales, and below are given particulars of tests carried out in that district.

(1) On a ruling gradient of 1 in 34 and bad weather conditions, the load taken behind the engine was 209 tons, consisting of 31 vehicles composed of 30 wagons and one 20-ton brake van. The load was started from rest with ease after the train had been brought to a stand on the gradient.

(2) On a ruling gradient of 1 in 40, 392 tons behind the engine was taken under fine weather conditions, the train consisting of 59 empty wagons and one 20-ton brake van. This load was also taken with ease, and it was estimated that six more 12-ton wagons could have been taken, but, unfortunately, the road was such that the trap points would not allow of any extra length of train.

(3) A passenger train working on a ruling gradient of 1 in 34 composed of 14 vehicles was taken behind the engine, the loading being 184 tons. This load was taken with ease, but no more coaches were added, as, owing to the shortness of the platforms, had the extra length been added, the time taken, owing to having to draw up a second time at each station, would have been so great that no gain would have accrued.

A total of 30 of these engines is being built, and 19 of them are already working in the Abergavenny district, where they are doing the work of 30 coal-side tank engines.

A DISADVANTAGE OF THE MONOPOLY PATENT.—In pointing out the development of the automatic spark control for automobile motors, one of the speakers at the S.A.E. convention referred to several patents which had been issued for some particular features of the devices which were necessary for future developments. Unless, however, the various inventors get together in some sort of a mutual agreement, it is apparently impossible for the best results to be obtained. If, as has been suggested on various occasions for many years, patents were granted with the understanding that they could be used by anyone on payment of royalty to the inventor, fragmental patents of this kind would help rather than hinder the final development of many useful devices. In the great majority of cases the inventor would probably receive far more than he does now, and it would be possible for the most enterprising concerns to manufacture devices which embody all that was known to be best, without regard to the origin of the patents. This would be of special benefit to the users, who are not interested in the quarrels of patentees, but who wish the best devices possible for their use.—"*American Machinist*," *October 20th, 1923, page 319.*

Railway Matters.

THE President of the Railway Benevolent Institution for next year will be Mr. William Whitelaw, the chairman of the London, Midland and Scottish Railway.

FROM some particulars given in an agreement, recently published, as to the pay of restaurant car staffs, it appears that the cooks start at 50s. per week for the first year and reach 60s. in their fifth year; the conductors start at 32s. and reach 36s., and the attendants begin at 24s. and receive 30s. in their fourth year.

THE South Yorkshire Joint Committee, a combination of the interests of the former Great Central, Great Northern, Lancashire and Yorkshire, Midland and North-Eastern Companies, has accepted the tender of Messrs. Mitchell Bros., Sons and Co., Glasgow, for the extension of the Committee's line from Tickhill to Harworth Colliery, a distance of 4 miles.

THE rare event of a general manager being advertised for is being witnessed just now. It is for the King's Lynn Docks and Railway Company—a property which was controlled under the Act of 1871, but which has not been absorbed. It has a created capital of £559,358, and possesses 1 mile 50 chains of running line, 10 miles of siding, and 4824ft. of quay in the docks.

THE passenger traffic for May, particulars of which have recently been made available in the Railway Statistics of the Ministry of Transport, was influenced by the fact that Whitsuntide was in that month this year and in June last year. This probably explains the increase of 8.32 per cent. in the number of passengers, of 2.77 per cent. in the passenger receipts, and of 5.86 per cent. in the passenger train miles.

THE forthcoming retirement is announced of Mr. H. A. Watson, the general superintendent of the North-Eastern Railway—now the North-Eastern section of the London and North-Eastern Railway. This fact calls for mention in this column because Mr. Watson has held his appointment for the unusually long period of twenty-two years, and because of his successful efforts to secure economical train loading and movement.

THE proposed reduction from 16s. 6d. to 10s. in the war bonus of the railway shopmen so as to bring them to the same level as the men in the engineering trade has not yet been made. The National Union of Railwaymen is willing, but the other crafts unions will not agree. The Ministry of Labour has had the matter in hand, but it has now informed the railway companies that it has been unable to get the latter unions to accept mediation.

A RETURN showing "the number of persons employed by the several railway companies of Great Britain during the week ended March 24th, 1923, and a comparison of the rates of pay at July 1st, 1922, and at July 1st, 1923, and also of the average weekly salary or wage and the average weekly earnings for the weeks ended March 19th, 1921, and March 24th, 1923, for certain selected grades," has been issued and can be obtained from his Majesty's Stationery Office, price 1s. 6d. net. Particulars of average weekly salaries or wages and of average weekly earnings are shown in this return for the first time.

IT is officially stated that the Moscow municipality has prepared a scheme for the construction of an underground railway in Moscow. This project originated before the war, and M. Starkoff, who at that time was manager of the Moscow tramway company and who is now deputy to the president of the Russian Trade Mission in Berlin, M. Stomaniakoff assisted in drawing it up. The Moscow municipality is, however, unable to carry out the scheme without the co-operation of foreign capitalists, and in this connection negotiations have already been opened by the Foreign Trade representation of the Moscow Soviet, the Movneitorg.

In August, 1922, the 10-span stone viaduct over the Blackwater at Mallow was destroyed by rebels. Its reconstruction, as a girder bridge of 10 spans, was entrusted to Sir W. G. Armstrong, Whitworth and Co., Limited, under the supervision of Messrs. J. F. Crowley and Partners, 16, Victoria-street, S.W. 1. Each span has a length of 51ft. 6in., and the bridge is 515ft. between its abutments. On Tuesday, the 16th ult., the new viaduct was formally reopened by a special train running over it, with President Cosgrave, accompanied by Sir William Goulding, the chairman of the Great Southern and Western Railway, on the footplate of the engine.

THE Railway Statistics for the month of May, recently issued as a Stationery Office publication, show that the tonnage carried was 16.05 per cent. more than in May, 1922. As the average length of haul fell from 51.22 miles to 50.59 miles the ton miles were only 14.62 per cent. higher. The reduction in rates for certain commodities which was made on May 1st this year led to the freight receipts being down 9.31 per cent. and the receipts per ton-mile 1.501d., as against 1.897d. The increase in tonnage was earned with only an increase of 7.09 per cent. in the freight train miles. Moreover, the average train load rose from 122.44 tons to 131.78 tons, and the net ton-miles per engine hour from 441 to 461.

IT was forty years last Wednesday—the 31st ult.—since the Watford accident. This accident had no very serious personal results, but it furnished a problem that gave considerable concern to railway officers. Some carriages were detached from an evening business train which, because of other trains, could not at once be disposed of. They were shunted about from one road to another, and, in the end, were forgotten and run into by an express from Liverpool. At that time the Board of Trade inspectors were constantly advocating the lock-and-block system of the late W. R. Sykes, and Colonel Yolland sent for that gentleman to ask how he would deal with such movements, seeing it was not the usual case of a down train shunted on to the up line freeing the up signals and locking the down, and then, when it returned to the up line, locking the up signals and freeing the down. To the Colopel's surprise, Sykes showed how it could be done, and that officer remarked "You are teaching me my business." Sykes' diagram of the movements was published as part of the Board of Trade accident report.

Notes and Memoranda.

IN the course of a paper by A. R. Sheen and Professor W. E. S. Turner, read before the Society of Glass Technology, the authors stated that it was found, on comparing it with the corresponding lime and magnesia glasses, that the titania glasses were less attacked than the lime glasses, especially in the earlier members of the series. The durabilities of the titania glasses were found to be practically the same as those of the corresponding magnesia glasses.

THE Canadian Minister of the Interior points out that, *per capita*, the Dominion has greater hydro-electric output than any other country, and four times that of the United States. Water power constitutes 88 per cent. of the electric generating capacity of the Dominion, and only 24 per cent. of that in the United States. The total installed horse-power in Canada has grown from 975,000 to 2,974,000 since 1910. The water power now developed in Canada represents an investment of over 620,000,000 dollars.

A MECHANICAL analysis was recently made, using the air analyser of the American Bureau of Standards, of a sample of foundry sand which contained coal particles and coal dust. This sand had been sent with a request for some method of removing the coal so that the sand could be used again in the foundry. The results of the mechanical analysis indicated that the coal could not be effectively cleaned out of the sand by means of air separation. It is probable that in cases of this kind some method of washing must be used.

THE *Manchester Guardian Commercial*, in the issue of October 25th, gives particulars of an automatically operated device which enables water to be used, as an admixture of petrol, for motor fuel. The water is used in the form of superheated steam and the exhaust manifold of the engine is used to vaporise the liquid and superheat it. In this form it passes to a special carburetter, which is the basic feature of the device. To this carburetter both petrol and steam feed are connected. On starting, the power is given by petrol fed through a slow-running jet, and this petrol is electrically assisted to vaporise quickly. The result is that the mixture can be brought into action within eleven seconds.

SOME valuable suggestions, in connection with the fuel situation in Canada, are contained in an interim report recently issued by the Dominion Fuel Board, which has been formed to study the underlying causes of coal shortages and methods by which they may be counteracted. The report of the Board, of which Charles Camsell is chairman, lays stress on the necessity of dispensing with the use of anthracite and the advisability of using Canadian coal so as to be independent of the United States as far as possible. The report urges the more general use of Alberta coal and the establishment of coking plants in the Dominion in order to utilise, to the best advantage, the large deposits of bituminous coal in Canada and the United States.

OIL, oil-shales, and natural gas have never provided Canada with any appreciable amount of fuel. An oilfield of limited area in south-western Ontario has been producing almost as long as the Pennsylvania fields, but for a number of years it has shown signs of exhaustion. In recent years oil has been found in Alberta and the north-west territories, and although prospects are encouraging, no large quantities have yet been produced. The oil-shales of New Brunswick and Nova Scotia, though promising, have not been utilised to any extent. There are supplies of natural gas in south-western Ontario and in Alberta, but in both fields evidences of depletion are shown. The possibility of the petroleum and natural gas resources of Canada assisting appreciably in the solution of the fuel problem is not bright.

THE *Electrical World* gives an interesting account of the way in which the engineers of the Southern California Edison Company altered an existing transmission line to make it deal with 100,000 horse-power more energy. The original operating voltage was 150,000 volts. The height of the steel towers was increased 10ft. and the line was re-insulated to make it suitable for 220,000 volts. The extraordinary thing about the operation was that all the work was carried out while the line was alive. The towers were lifted bodily and an extension of the proper height was made underneath. The re-insulation consisted of increasing the number of insulators in each string from eleven to thirteen. The work of raising 1400 towers took six months, and in the same time the insulators on 480 circuit routes were dealt with. This conversion has effected a great saving in cost over the erection of new lines to carry the additional power.

FOR the purpose of ascertaining the relative merits of riveted as compared with electric-welded tanks, four steel tanks, 4ft. in diameter and 10ft. long, made of $\frac{1}{16}$in. mild steel plates, were tested under hydrostatic pressure by the American Bureau of Standards. The tanks were designed for a stress of 16,000 lb. per square inch, at a working pressure of 200 lb. per square inch. Two of the tanks were butt-welded, one was lap-welded, and the fourth was of the ordinary lap-riveted construction. The ends of the tanks were spherical, having a radius of 4ft. Strain gauge measurements were made at various portions of the tanks and at pressure increments of 50 lb. per square inch until failure. The results of the hydrostatic tests proved rather unsatisfactory as a comparison of the relative strengths of the different types of construction. On account of secondary failures, such as leaks around the fittings, the possible strength of the tanks was not reached. In fact, the secondary failures were responsible for fracture in each case. In one tank the failure was at the weld around a 2in. pipe outlet; in the second, at the manhole; in the third, at the end transverse weld; and in the riveted tank at the end transverse riveted joints. The first two failures might have been obviated by better welding of the pipe fittings and manhole saddle to the shell. Extra reinforcement at the junction of the spherical end to the cylindrical shell would have reduced the stresses at the junction where the other two tanks failed. The location of the end transverse seam or riveted joint farther back on the shell of the tank would have taken this joint out of the region of high stress intensity caused by the abrupt change in direction of force at the junction of the spherical end of radius 4ft. to the cylindrical shell of radius 2ft.

Miscellanea.

THE Department of Overseas Trade is informed from a reliable source that the restrictions in Japan on the use of telegraph codes have been withdrawn in areas not under martial law.

FINAL measurements, since completion, show the gross tonnage of the Atlantic Transport liner Minnewaska, London's largest liner, as 21,716 tons, as against the previous approximation of 21,400.

WE are informed that a number of well-known firms have under consideration a scheme for forming an organisation for selling products of engineering and allied trades, in Italy, entirely on a co-operative basis.

IN the technical paper No. 8 of the Fuel Research Board the steaming of Wigan Arley coal in vertical gas retorts is dealt with at considerable length. The report can be obtained, price 9d., from H.M. Stationery Office.

REPRESENTATIVES of French and American interests in combination with Chilean financiers, have formed a company for the installation of a powerful wireless station to communicate with Europe. It is stated that the permission of the Government to carry out the scheme has been obtained.

IT has been reported that the makers of aluminium goods in Germany have lately been buying increased quantities of aluminium bars from Switzerland, but this is denied by them. They maintain, in fact, that the Swiss makers of bars are asking more money than, with their depreciated exchange, Germany can afford to pay.

ACCORDING to a report from the Tokyo Electric Light Company, the hydraulic power stations and transmission lines, including the underground cables, are all safe. Out of seventy transforming and sub-stations in Tokyo and Yokohama, twelve small stations were destroyed. Out of 100,000 poles for distribution in Tokyo and Yokohama, 35,000 were destroyed.

THE opening of the sixteenth electrical exhibition at New York, on October 18th, illustrated the wonderful extent to which electricity has become the handmaiden of the American household. Mr. Thomas Edison, who presided at the opening ceremony, predicted that the development of electrical devices would be even more marked in the next ten years than in the last decade.

AN interesting ceremony recently took place at a meeting of the Royal Naval Reserve Advisory Committee when Engineer-Captain W. J. Willett Bruce was presented with the Reserve Decoration for long and meritorious service. The decoration was bestowed by Vice-Admiral Sir Hugh Tothill. Engineer-Captain Willett Bruce has been a member of the R.N.R. for thirty-five years, and is chief superintendent engineer of the White Star Line, with which he has been connected for forty-two years.

THE number of persons on October 8th, 1923, recorded on the live registers of the Employment Exchanges in Great Britain was 1,251,600. This was 5418 more than in the preceding week, but 234,278 less than the figure recorded on January 1st, 1923. The total included 934,300 men, 43,800 boys, 233,500 women, and 40,000 girls. In addition, the number working systematic short time and drawing benefit for intervals of unemployment was 66,200 on October 8th, as compared with 73,702 on October 1st, and 56,261 on January 1st, 1923.

TRAFFIC facilities at Shepherd's Bush Station, Central London line, are to be improved. The lifts will be superseded by two escalators, which are now in an advanced stage of construction. These escalators will be carried right to the platform level, thus obviating the necessity of traversing long corridors, as at present. The present booking office will be demolished, and in its place Passimeter booking booths will be installed. The cost of carrying out the improvements will be £46,000, and it is anticipated that the whole of the work will be completed by the end of the year.

ALTHOUGH it is now possible to insure against practically every kind of risk, it will probably be news to some of our readers, states the *Electrician*, that Coolidge and X-ray tubes can be insured against breakage, fire, theft and perforation. There is, as every radiographer knows, an ever-present risk of puncture from various causes, most of which are beyond the control of the user, and, further, there is risk of accidental breakage in handling and working, either by the radiographer or his assistants. Less frequent, perhaps, but still reasonably possible, there is the risk of loss or damage by theft. Obviously, it is wise to insure against these risks if a satisfactory means of insurance is available.

UNDER the auspices of the Widnes Scientific Society, Mr. A. E. Malpas, chief engineer to the United Alkali Company, recently gave a lecture on "The Metric System, with Special Reference to Chemical Manufacture." The lecturer stated that the outstanding advantage to the system from the chemical and scientific point of view was the numerical equivalence of the unit of weight—the gramme—and the unit of volume—the cubic centimetre—at unit density. Mr. Imison, who took part in the discussion, said that the metric system had been scrapped at the works of the United Alkali Company, and disagreed with the lecturer's contention that the metric system and the English system could not be used concurrently with efficiency.

DURING the last session of the Bengal Legislative Council, the Bengal Ropeways Bill, which had been under consideration for some time, was passed into law. It is anticipated that advantage will be taken of the Act, among other industrialists, by colliery proprietors in order to provide transport in connection with their mines. The Act applies, of course, to the Bengal Presidency only, and has no application to the large and important coalfields situated in the neighbouring provinces of Bihar and Orissa, but colliery owners in these fields, too, wish to take advantage of it. The Committee of the Bengal Chamber of Commerce has, accordingly, recommended the Government of Bengal to move the Government of Bihar and Orissa to undertake similar legislation, and it is understood that necessary action has been taken in the matter.

THE RENO MARINE SALVAGE SYSTEM.

(*For description see page 471*)

FIG. 5—THE TRACTOR, SHOWING WINDING DRUM AND DRILLS

FIG. 6—DRILLING OPERATION ON TEST PLATE

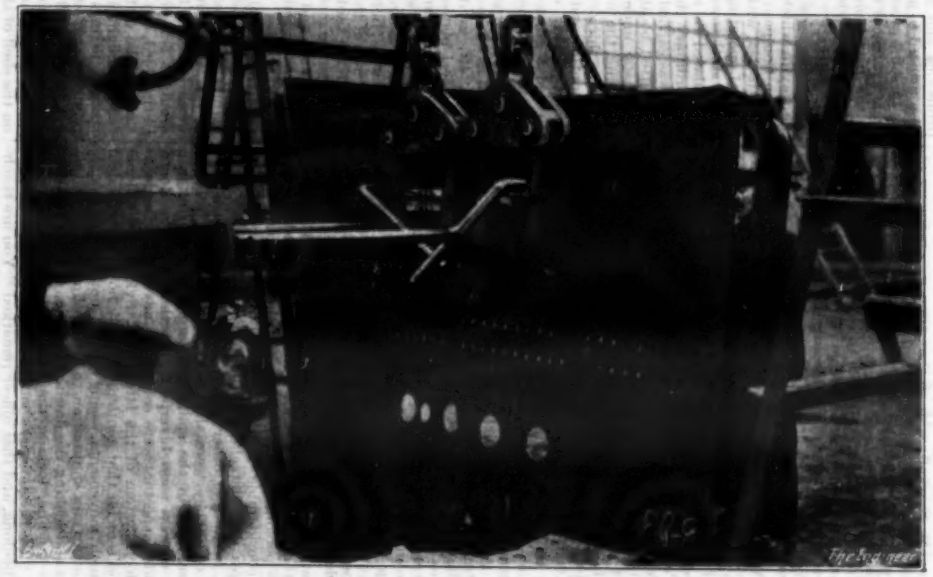


FIG. 7—PLACING HOOKS IN POSITION WITH DIRECTING BARS

FIG. 8—HOLES ABOVE BILGE KEEL DRILLED UNDER WATER

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The Engineer

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PUBLISHER'S NOTICES.

*** *With this week's number is issued as a Supplement a Two-page Plate illustrating the Reno Marine Salvage System. Every number as issued by the Publisher contains a copy of this Supplement, and Subscribers are requested to notify the fact should they not receive it.*

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By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

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THE ENGINEER.

NOVEMBER 2, 1923.

Optical Stress-strain Recorders.

It is now some twelve years since Professor Dalby, of the City and Guilds Engineering College, dissatisfied, in a measure, with the ordinary means of obtaining a stress-strain record from a metal specimen under test, conceived the idea of devising an instrument in which optical and photographic methods would replace the usual mechanical details, the string, the paper and the pencil. At first sight, the fundamental merits of the idea may not appear to be great, for in its broad principle it had been forestalled by the very similar departure that had been already made in the case of indicators for steam and internal combustion engines. Moreover, the same or similar objects were sought, namely, the elimination of errors arising from friction, the stretch of the cord and inertia effects. The true merits of the several forms of optical stress-strain recorders which Professor Dalby has now succeeded in bringing to a high degree of perfection are, however, like those of any optical indicator for engines, to be judged, not simply by the broad principle involved, but by the constructional details, the applicability of the devices, and, above all, by the new information which their experimental employment permits us to gather. Judged under any and all of these heads, the Dalby instruments appear to us as being devices of very great interest and value, and as affording the means whereby the scientific understanding of the nature and properties of engineering materials may be considerably extended.

The parent device in which Professor Dalby first embodied his ideas, the optical load-extension recorder, has already been described, somewhat briefly perhaps, before the Royal Society, the Naval Architects and the Institute of Metals. In the form it has now assumed its optical system consists of two mirrors mounted on axes at right angles to each other, whereby a ray of light from a point source is reflected through a lens and focussed on a photographic plate. One end of the test specimen is coupled to the end of a "weigh bar"—a rod of steel of considerably greater cross section than the specimen—and the two elements, specimen and weigh bar, thus connected in series, are inserted between the grips of a tensile testing machine. The gauge length on the specimen is defined by two collars turned on it. An extensometer of simple form and low ratio—3 to 1—is applied between these collars, and, when the gauge length alters, causes the first mirror to tilt, and so produce a vertical movement of the spot of light on the photographic plate. Under the applied load transmitted through the weigh bar to the specimen, the weigh bar stretches, and causes the second mirror to tilt in such a way as to produce a horizontal movement of the spot of light across the photographic plate. Thus under the combined action of the two mirrors, the spot of light traces out the familiar load-extension diagram, which by means of a previous calibration of the weigh bar and the mechanico-optical extensometer system, can be analysed quantitatively. The chief features of interest in the design of the instrument are undoubtedly the use of the weigh bar as a means of measuring the applied load, and the fact that all the other details—from the source of illumination to the camera bellows and plate holder—are supported solely from the weigh bar. The weigh bar extends very slightly under the load, and as a consequence its use eliminates the inertia effects which seriously influence the readings obtained with nearly all forms of mechanical autographic recorders, and which practically prohibit the making of a test at anything approaching a high speed. The fact that all the details are supported from the weigh bar permits the device, delicate though its action is, to resist the jar arising when the specimen breaks. It is thus possible to obtain a record of the load-extension right up to and including the moment of fracture. In order that the full history of the specimen from start to break may be recorded within the compass of a half-plate negative, the magnification of the strain has to be kept low, the ratio fixed being about 4 to 1. The first 4/100th of an inch of the extension is, however, a very important part of the curve, and to enable it to be studied minutely, Professor Dalby has produced a modified design of optical recorder, which magnifies the extension about 150 times. The chief difference is to be found in the details of the extensometer, but there is an important addition, namely, a microscope, focussed on an index carried by one of the extensometer links, whereby the progress of the extension may be closely observed independently of the photographic record. This load-and-elastic-extension instrument can, by a simple alteration to the weigh bar, be used to investigate compression as well as tension. Yet another instrument has recently been produced, an optical torque-twist recorder, characterised by the same fundamental features as the others, namely, a two-mirror optical system influenced in part by the twist of the specimen and in part by the twist of a calibrated "torque tube," to which the specimen is coupled in series. This device enables the first few degrees of twist of the specimen to be very closely observed. It is not used to test the specimen to destruction, for such a test yields little information of value.

It is no doubt possible to criticise the details of all these various recorders on much the same lines as those along which criticism has been directed against optical engine indicators. But such criticism cannot obscure the fact that the devices which Professor Dalby has invented provide very refined means of examining and recording the behaviour of metals under test, more refined, we believe, than any hitherto employed for the purpose. Already by their use we seem to be on the verge of receiving new enlightenment on the manner in which metals react and accommodate themselves to the application of load upon them. In a book, entitled "The Strength and Structure of Steel and other Metals," which Professor Dalby has just had published, some of the results obtained by means of the devices are given and discussed. Close attention, it will be found, has been concentrated upon observing the behaviour of tension, compression and torsion specimens after they have been stressed just beyond the primitive yield point. When the stress is released and re-applied, the specimen exhibits imperfect elasticity, and a new yield point, and on repeating the process, releasing the load and re-applying it to its original value, a series of loops is traced on the photographic plate. These loops are familiar to all who have used an extensometer in a testing machine, but what we believe is novel is that with the increased accuracy of the means at his disposal for recording them, Professor Dalby has succeeded in establishing very fair evidence in favour of his view that the area enclosed within the loops and the rate at which it increases from loop to loop are characteristics of the metal under test from which a great deal concerning its past history and probable behaviour in practical use may be deduced. In view of the fact that the loop area represents the work expended by virtue of the existence of elastic hysteresis—that is to say, that it is a measure of the energy absorbed by the specimen on account of the imperfection of its elasticity—Professor Dalby's view would appear to be capable of ready scientific explanation. It may perhaps be objected from

the practical point of view that the instruments are too refined for ordinary workshop use. Doubtlessly, they will fail to supplant the ordinary works testing machine, but it would seem highly probable that by their employment facts will be established which will make still clearer the very restricted value of the ultimate strength figures which are usually the sole items upon the measurement of which such machines are employed. It may be objected, too, that as engineering structures are designed in such a way that the stresses in the members never approach the yield point, the loop area test is an artificial one, that at the most it only reveals the behaviour of a metal after it has been brought into a condition it cannot acquire in practice. Such an argument, it may be replied, can be used even more strongly against the determination of the ultimate strength. That test relates to a stage in the behaviour of the metal still further beyond the useful region than the Dalby test. By almost unanimous consent, the elastic limit or yield point is now regarded as the correct factor upon which to base design, and in so far as Professor Dalby's instruments throw light on the behaviour of the metal in the neighbourhood of these points and upon the factors affecting the variation of their position, are the devices and the results arrived at by their use of first-class importance to practical engineers.

Air-heaters v. Economisers.

In no direction is steam engineering making more progress than in the improvement in the use and design of steam boilers. For many years the world had gone on tolerating boilers as they were, bringing out new designs indeed, but making no great effort to increase the efficiency or even to examine it. Then a movement towards a more scientific attitude took place; the CO_2 recorder, and kindred devices, were introduced, and investigators, here and there, began telling boiler users that they were obtaining very low efficiencies. As a rule, their accusations fell on deaf ears. The engineers of those days were quite satisfied that they knew all that it was necessary to know about boilers, and they laughed at the laboratory apparatus which the new school of thought wanted them to fit up in their boiler-houses. There was some excuse for their attitude. Coal was cheap, labour cost little more than half what it does to-day, rates were low and the burden of very heavy taxation had not to be met. Hence, it came about that a few extra tons per day did not matter very much, and boiler users preferred to carry on as they were rather than incur further capital charges for new boiler-house equipment. There were, of course, exceptions, but taking boiler plants as a whole, the evidence seems to indicate that the average thermal efficiency was nearer 50 than 60 per cent. But even before the war a change was coming about, and during the war on account of the scarcity of fuel, and since the war on account of the increase in cost of everything connected with steam generation on the one hand, and the necessity of reducing production costs on the other, greater attention is being given to the control of boiler-houses and to the improvements of boilers themselves.

At sea, the most notable recent advance is the rapid increase in the use of liquid fuel, whilst ashore the feature that strikes the casual observer at once is the enormous increase in the size of steam generators. But there are developments of more importance. Of these the most notable is the coming of much higher pressures, but not less important is the introduction of powdered fuel firing, and the extension of hot-air supply to boiler furnaces. The latter introduces difficult problems owing to the extremely high temperatures that may be reached, but excellent thermal efficiencies have been attained with it. In his Presidential Address to the Institution of Engineers and Shipbuilders in Scotland, Mr. J. Howden Hume, a nephew of Mr. James Howden, whose system of air heating has been applied to some 24,000,000 horse-power at sea since its introduction in the eighties, gave some figures which showed that with the Wallsend-Howden system of burning liquid fuel with hot forced draught thermal efficiencies of nearly 84 per cent. had been attained, and when using the Ljungström system of mechanical air heating, efficiencies of very nearly 85.5 per cent. had been reached with coal burning, and of over 87 per cent. with oil firing. Such results, if there were no countervailing factors, would lead to the rapid extension of the system. But air preheating is no new thing, yet hitherto it has never successfully challenged the economiser, and is only used to any great extent in marine practice where the use of the economiser is out of the question. Mr. Howden Hume believes that with the advance in pressures, and the consequently increased difficulty of producing satisfactory economisers, hot draught will find extended use ashore. On that point no one can safely venture an opinion. When Mr. Patchell introduced the subject at the Conference of the Institution of Mechanical Engineers in June, 1921, he was unable to express a decided opinion one way or the other himself, and the discussion still left the matter in doubt. The fact is that there is little to choose between air preheating and economising, as far as efficiency is concerned, and the adoption of one or the other will turn, on shore, on questions of design and upkeep. Mr. Hume is quite right in his remarks concerning the unsuitability of the cast iron economiser for very high pressures, but the economiser is so well established in power-house practice that it is less likely to be rejected than to be modified to suit the new conditions. At sea the advantages are all the other way; there, the hot draught holds its own owing to the low weight of the equipment. It is of not a little interest to note that the Babcock and Wilcox boiler for 1200 lb. pressure, described by Mr. Jacobus at the September meeting of the Iron and Steel Electrical Engineers—see THE ENGINEER of October 12th, 1923—is fitted with an economiser composed of 2in. seamless steel tubes expanded into forged steel boxes. What the capital cost of such an economiser may be, and what the cost of upkeep will amount to, we do not know; but both figures must, obviously, be high, and in the case of such extreme pressures as 1200 lb. per square inch, there would appear to be a good case for heating the air instead of the feed. The high-pressure boilers to which we have alluded, are only now being made, and experience alone can show in how far they are satisfactory. The Powell Duffryn boilers, which operate at 350 lb. pressure, are fitted with air heaters as well as economisers, and in the course of time should afford valuable data on which to form a logical opinion.

There is, as we have said, little to choose, from the point of view of efficiency, between the air heater and the economiser, for both it may be claimed that they reduce the coal consumption, in favourable circumstances, by something like 10 per cent. But both make some call for power, one for a fan and the other for a scraper, so that the net gain is less than appears in the increase in thermal efficiency. The economiser has held its own in power-house practice for many years, and if it were not for the change in condition which is being brought about by the adoption of higher pressures, there would be little or no reason to anticipate a departure from current practice. But with pressures in the neighbourhood of 1000 lb. per square inch, the cast iron economiser is out of the question. The steel economiser is the only alternative, and it will, undoubtedly, present problems of its own, the solution of which may prove more costly than the adoption of air heating. The division of duties, as at Bargoed, does not get over the trouble, for high pressures have still to be faced, though it may reduce the capital expenditure. Hence, it will be seen that there is no clear indication of the direction which will be taken as pressures increase. The rivalry between the two systems provides us with another of those examples of which steam engineering is full, in which a decision cannot be reached by argument, but must be found by actual everyday experience. The economiser is in possession; it will be interesting to see if the air heater can oust it.

The International Railway Congress

THE Permanent Commission of the International Railway Congress Association announces that all the reporters on the questions on the programme for the Congress to be held in London during the second half of the year 1925 have now been appointed. The subjects and the principal reporters are as follows:—

Section I.: Way and Works.—Report Ia: Different methods of maintenance and repair of track by the administration, by contractors, by piecework, or by premiums. Mechanical appliances. Comparison from the technical and economical point of view. Report Ib.: Dispensing with crossing keepers. Visibility of the trains from the crossing. Warning notices and signals. Reporter for Great Britain and Colonies: Mr. W. H. Coomber, divisional engineer, London, Midland and Scottish Railway, Hunts Bank, Manchester. Reporter for America: Mr. G. J. Ray, chief engineer, Delaware, Lackawanna and Western Railroad, Hoboken, N.J.

Report IIa.: Initial causes of breaking of rails. Means employed to reduce the number of these breakages as much from the point of view of the method of use as from that of the specification of material employed. Report IIb.: Rail joints; most economical and efficient arrangement. Reporter for Great Britain and Colonies: Mr. C. J. Brown, chief engineer, Great Northern and Great Central sections, London and North-Eastern Railway, King's Cross, N. 1. Reporter for America: Mr. W. C. Cushing, engineer of standards, Pennsylvania Railroad, Philadelphia.

Report III.: Shunting and marshalling yards for goods trains. Lay-out and organisation. Reporter for Great Britain and Colonies: Mr. R. H. Nicholls, superintendent of the line, Great Western Railway, Paddington, W. 2. Reporter for America: Mr. Samuel T. Wagner, chief engineer, Philadelphia and Reading Railway, Philadelphia.

Section II.: Locomotives and Rolling Stock.—Report IVa: Fuel and its combustion—(*a*) Choice of fuel—coal, mixing of coals, peat, oil fuel, pulverised fuel, mixing of solid and liquid fuels; (*b*) apparatus for the combustion of solid fuel—rocking grates, &c.—liquid and pulverised fuels; (*c*) mechanical stokers; (*d*) smoke combustion; spark arresters. Report IVb.: Lubrication of axle-boxes for all rolling stock—(*a*) Axle-boxes, plain bearings, roller and ball bearings; (*b*) lubricants. Reporters for Great Britain and Colonies: For IVa.: Mr. C. B. Collett, chief mechanical engineer, Swindon; for IVb.: Sir Henry Fowler, deputy chief mechanical engineer, London, Midland and Scottish Railway, Derby.

Report V.: Electric locomotives. Reporter for America: Mr. J. T. Wallis, chief of motive power, Pennsylvania Railroad, Philadelphia. Reporter for all other countries than America: Monsieur M. Weiss, chief engineer of traction, Swiss Federal Railways, Berne.

Report VI.: Locomotive sheds. Installations for (*a*) inspecting engines; (*b*) washing-out boilers and blowing through the tubes; (*c*) lighting up engines and getting rid of the smoke; (*d*) loading fuel on the engines, mixing fuels, disposal of ashes; (*e*) for the recovery of coal and coke from the residues of combustion. Reporter for Great Britain and the Colonies: Mr. R. E. L. Maunsell, chief mechanical engineer, Southern Railway, Ashford. Reporter for America: Mr. R. W. Bell, general superintendent of motive power, Illinois Central Railroad, Chicago.

Section III.: Working.—Report VII.: Dispatching or control systems. Reporter for Great Britain and Colonies: Mr. J. H. Fellows, chief general superintendent, London, Midland and Scottish Railway, Derby. Reporter for America: Mr. H. E. Hutchens, general inspector of passenger transportation, Southern Railway, Washington.

Report VIII.: Suburban services. Reporters for Great Britain and Colonies and for America: Messrs. H. E. Blain and Arthur R. Cooper, assistant managing director and chief engineer respectively, Metropolitan, District, and other London underground railways, Westminster.

Report IX.: Fixed signals. Reporter for Great Britain and Colonies: Mr. W. J. Thorrowgood, signal and telegraph superintendent, Southern Railway, Wimbledon. Reporter for America: Mr. W. H. Elliott, signal engineer, New York Central Railroad, Albany.

In Section IV. there are to be reports on (X.) the eight-hour day on railways; (XI.) railway statistics; and (XII.) allocating the cost of joint stations and lines. In Section V. the reports are to be (XIII.) establishment of light railways; (XIV.) concessions for light railways; and (XV.) traction for light railways.

BOOKS RECEIVED

The Lathe Users' Handbook. By C. M. Linley. London: Scott, Greenwood and Son, 8, Broadway, Ludgate, E.C. 4. Price 7s. 6d. net.

Car Lighting by Electricity. By Charles W. T. Stuart. London: Simmons Boardman Publishing Company, 34, Victoria-street, S.W. 1.

Radio Telegraphy and Telephony. By E. W. Marchant. London: Hodder and Stoughton, Limited, Warwick-square, E.C. 4. Price 6s. net.

Wireless Facts and Figures. By A. V. Ballhatchet. London: Percival Marshall and Co., 66, Farringdon-street, E.C. 4. Price 6d. net.

Radio and High-frequency Currents. By E. T. Larner. London: Crosby Lockwood and Co., Stationers' Hall-court, E.C. 4. Price 3s. 6d. net.

Successful Wireless Reception. By Paul D. Tyers. London: Percival Marshall and Co., 66, Farringdon-street, E.C. 4. Price 1s. 6d. net.

Strength and Structure of Steel and Other Metals. By W. E. Dalby. London: Edward Arnold and Co., 41 and 43, Maddox-street, W. 1. Price 18s. net.

Proceedings of the Institution of Mechanical Engineers. Volume: January to April, 1923. London: Published by the Institution, Storey's-gate, S.W. 1.

Blasting with High Explosives. By W. Gerard Boulton. London: Sir Isaac Pitman and Sons, Limited, Parker-street, Kingsway, W.C. 2. Price 5s. net.

Motor Vehicles and their Engines. By Edward S. Fraser and Ralph B. Jones. London: Crosby Lockwood and Son, 7, Stationers' Hall-court, E.C. 4. Price 16s. net.

Annual Report of the Smithsonian Institution. Showing the Operations, Expenditure and Condition for year ending June 30th, 1921. Washington: Government Printing Office.

Journal of the Iron and Steel Institute. Vol. CVII. London: Published by the Institute, 28, Victoria-street, S.W. 1, also by E. and F. N. Spon, Limited, 57, Haymarket, S.W. 1.

The Life of Sir William White. By Frederick Manning. With an Introduction by the Right Hon. Lord George Hamilton. London: John Murray, 50a, Albemarle-street, W. 1. Price 21s. net.

The Iron and Steel Institute: Carnegie Scholarship Memoirs. Vol. XII. London: Published by the Institute, 28, Victoria-street, S.W. 1, and by E. and F. N. Spon, Limited, 57, Haymarket, S.W. 1.

Obituary.

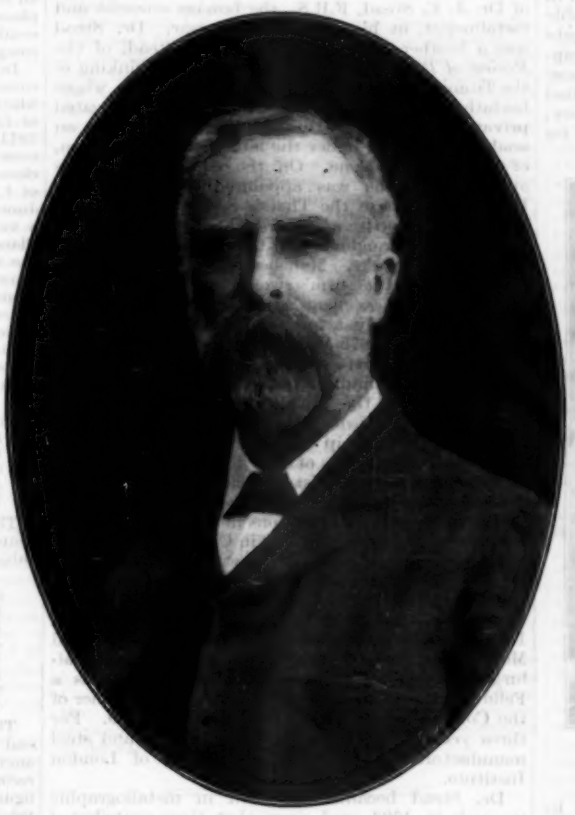
HENRY ALFRED IVATT.

WIDESPREAD regret will be felt at the death of Mr. H. A. Ivatt, which took place at Hayward's Heath, in Sussex, on the 25th ult. Mr. Ivatt in the course of a busy life had filled many posts, but the most important position he held was that of chief locomotive engineer to the Great Northern Railway.

Henry Alfred Ivatt was born in the year 1851, and he had therefore reached the age of seventy-two years at the time of his death. He was the eldest son of the late Rev. A. W. Ivatt, Rector of Coveny-cum-Manea, in Cambridgeshire. He was educated in the Upper School, Liverpool College, and at the age of seventeen was bound apprentice at Crewe. The locomotive engineer of the London and North-Western was, at the time, Mr. John Ramsbottom, but before Mr. Ivatt had severed his connection with the line, Webb had succeeded Ramsbottom, so that he served under two very distinguished locomotive engineers. Despite this influence, and unlike other famous locomotive engineers who passed through Crewe, the types of engines with which he had become familiar there influenced his own designs but little. Indeed, so far as his career on the Great Northern is concerned, he not only did not imitate the work of any British locomotive engineers who had gone before—not even, to any great extent, with one interesting exception, that of Mr. Patrick Stirling who immediately preceded him—but, from the very first, launched out into directions entirely his own.

It is permissible to imagine that Mr. Ivatt had it in mind, from the outset of his career, to become the locomotive superintendent of one of our big railways. It is, at any rate, significant that as soon as the four years' period of his apprenticeship at Crewe was completed, he became an ordinary fireman on the line, and must have discharged the arduous duties well, for, in the latter part of the twelve months during which he served in that capacity, he was employed on fast express trains running north and south from Crewe. The practical knowledge which he obtained at this time served him in good stead in after life. Subsequently, he spent six months under Mr. G. P. Neale in the Traffic Department of the line, after which he was made Assistant Foreman at the Steam Shed at Stafford. Of this period of his life he delighted to talk, and many a good story he told of his experiences, always with that touch of humorous enjoyment and good-natured wit which endeared him to his friends. In September, 1874—when he was but twenty-three years old—he was put in charge of the Locomotive Department at Holyhead, and two and a-half years later was promoted to the Chester District. That was in the early part of 1877, and in the October of that year he was appointed District Superintendent of the Southern Division of the Great Southern and Western Railway of Ireland, with headquarters at Cork. He remained with the Irish Company for rather more than twelve years. In 1882 he became Assistant Locomotive Engineer and Works Manager at Inchicore, four years later being made Locomotive Engineer of the line.

It was in 1895 that Mr. Ivatt was offered the position of Chief Locomotive Engineer to the Great Northern Railway, and in the March of the following year he went to Doncaster. There had only been two prior holders of the position—Sturrock and Stirling—but they had both been men of outstanding merit and original ideas. Mr. Ivatt found himself in charge of many fine locomotives, which were capable of doing magnificent work with the train loads usual at that period, but he entered upon his duties just at the very time when large increases in traffic were being experienced. Almost at the very first he was called upon to build more powerful engines than those previously in existence, so as to cope with the increased weight of the trains which were continuously being lengthened to provide accommodation for the growing numbers of travellers. It would be impossible here to enumerate the different types of locomotive which he evolved to meet the calls made upon him by the traffic department of his line. Reference may, however, be made to some of them. His first engine "took the rails" at the end of '96, and in two respects marked a departure from the practice of Patrick Stirling, for it was a four-coupled engine with a leading bogie, and actually had a steam dome. Externally, it resembled closely the last engine built by Ivatt at Inchicore, but differed from it in that it was not a compound. Its cylinder dimensions were 17½in. by 26in., and its driving wheels 6ft. 7½in. in diameter. Mr. Ivatt was the first to introduce into this country the "Atlantic" type of engine, and he did so in 1898. The engine, No. 990, had a heating surface of 1442 square feet, and the particularly large grate area, for that time, of 26 square feet. The boiler, which was 4ft. 8in. in diameter, was built for a working pressure of 175 lb. per square inch. The coupled wheels were 6ft. 8in. in diameter, and the bogie and trailing wheels 3ft. 8in. in diameter. The two cylinders, which were arranged outside the frames, were 18½in. in diameter by 24in. stroke. This engine was particularly successful, and, with it, trains which, up till its introduction, had to be "double headed," could be worked comfortably. Writing of his experiences with it, Rous-Marten said in our columns, August 26th, 1898: "No. 990 is beyond all comparison the largest and heaviest express engine in the kingdom." About the same time he turned out from Doncaster engine No. 266, a single driver with inside cylinders 18in. by 26in. and 7ft. 7½in. driving wheels. It had a leading bogie and a pair of small trailing wheels. A few years later he repeated the type with 19in. cylinders. The success of "990" led to the construction of a score or so of similar engines, and Mr. Ivatt went on introducing improvements into subsequent designs until he had evolved a type which, in its epoch, was probably the most powerful of its kind. On several of them he applied his four-cylinder compound principle with satisfactory results. In the first of these engines the high-pressure cylinders, which were outside the frames, were 13in. in diameter and had a 20in. stroke, the low-pressure cylinders being inside the frame, and having diameters of 16in. and a stroke of 26in. In a subsequent engine of this type the low-pressure cylinders were made 18in. in diameter, the stroke remaining the same as in the first engine. In still another there were four high-pressure cylinders, each 15in. in diameter, with a 26in. stroke and with Stephenson link motion actuating piston valves.



HENRY ALFRED IVATT

Mr. Ivatt's activities were, of course, by no means confined to the design of passenger engines. He was early in the field in bringing out a locomotive capable of dealing with the much heavier mineral trains which, on the score of economy, it was then being found necessary to haul. In 1901 he introduced an exceedingly powerful locomotive which successfully hauled from Peterborough to London a train of fifty-two fully loaded 10-ton coal trucks—a load which, with a 20-ton brake, represented some 750 tons. The return journey to Peterborough with sixty empty trucks was made the same day. This engine, No. 401, had eight-coupled wheels, 4ft. 8in. in diameter. The cylinders were inside the frames, and were 19½in. in diameter by 26in. stroke. The boiler had a heating surface of 1438¾ square feet, made up of 1302 square feet in the tubes and 136¾ in the fire-box, which had a grate area of 24½ square feet. The safety valves were set to blow off at between 175 lb. and 180 lb. per square inch. The first of these engines—which, by the way, weighed with its tender, in running order, 95¼ tons—was put into service in February, 1901. A little later in the same year we had an opportunity of being on the footplate during one of the runs from Peterborough to London, and in our report we spoke of the journey as having been in every way successful. There are some long stretches of 1 in 200, and the speed up them varied from 17 to 20 miles per hour. On the level the speed was from 30 to 32 miles per hour, and the same speed was kept down inclines, no attempt being made to exceed it. The train was frequently pulled up dead by signals, not unseldom on steep inclines, but the engine never had any difficulty in starting again, and it was quite evident that a heavier load might have been hauled.

One secret of the success of Mr. Ivatt's engines was the fact that he believed in having plenty of boiler power. The *Railway Magazine* for September, 1910, in an article on the Diamond Jubilee of the Great Northern Railway, said of him that, like Mr. Sturrock, he had always maintained that the "real power of the locomotive was its capacity for boiling water." At any rate, he did not under-boiler his engines, and it is noteworthy that the very first engine which he designed for the Great Northern Railway had considerably more heating surface than any of Mr. Stirling's engines had had. The latest type of Ivatt "Atlantic" engine had a boiler 5ft. 6in. in diameter and a heating surface of 2500 square feet.

We spoke above of there being one exception to the general rule that Mr. Ivatt did not follow in the steps of his predecessors in office. He did build some single-drivers locomotives, but though they, to some extent, were of the same design as Mr. Stirling's famous single-driver engines, they were undoubtedly an improvement on the latter. Indeed, Ivatt actually succeeded in bettering the performances of some of the Stirling engines by fitting them with larger-domed boilers. His own first single-driver engine was very similar to the latest type of Stirling single-drivers, and had the same sized wheels and cylinders, but it had a much larger boiler and did considerably better work. Later his single-drivers were given 19in. by 26in. cylinders and 1269 square feet of heating surface, as compared with the 1031 square feet of Mr. Stirling's engine.

Mr. Ivatt was anything but conservative. He was always on the look out for anything which would add to the efficiency of the locomotive. He was, we believe, the first to employ the Walschaerts' valve gear in this country, and he was certainly among the first to adopt superheating on his engines—both passenger and goods. He himself took out several patents in connection with locomotives. During his stay in Doncaster—and he did not retire until 1911—he endeared himself to all who served under him by the kindly interest which he took in their well-being. The affection in which he was held was exemplified by a presentation which was made to him in Doncaster Drill Hall a few months after he retired. The occasion was December 2nd, 1911, and the presentation took the form of a portrait in oils of himself, which had been executed by Mr. Lance Calkin. More than 200 persons had subscribed for the portrait, and the smoking concert at which the presentation was made was attended by a numerous gathering of officers and representatives from every branch of the railway, who joined in wishing the retiring Engineer full enjoyment of a well-earned leisure.

Mr. Ivatt was succeeded in the position of Locomotive Engineer to the Great Northern Railway by Mr. H. N. Gresley, who has now become Chief Mechanical Engineer to the London and North-Eastern Railway. He—Mr. Ivatt—devoted all his energies to the line. He was created a Justice of the Peace while he held office, but at his own request he ceased to be a magistrate because he felt that he could not discharge magisterial duties without interfering with his railway work. In the same way, he found himself bound to refuse the distinction of being a Vice-President of the Institution of Mechanical Engineers, though he was on the Council of that body. His only son, Mr. H. G. Ivatt, is Works Manager at Stoke on the North Staffordshire Section of the London, Midland and Scottish Railway.

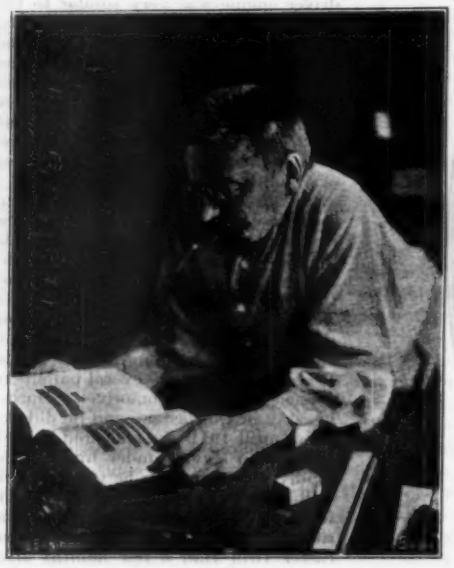
DR. S. P. STEINMETZ.

THE death of Dr. Steinmetz, the eminent electrical engineer, mathematician, and prolific writer and lecturer on electrical subjects, occurred last week at Schenectady. Dr. Steinmetz studied at Breslau, Berlin, and at Zurich, but at the age of twenty-four he landed in America in the year 1889. The ship La Champagne arrived one Saturday afternoon and put the cabin passengers ashore, but on account of the regulations that were then in force, the steerage

passengers, among whom Steinmetz and his friend Asmussen were included, were kept on board for inspection until the following Monday.

Steinmetz' first experiences in America were not happy. He could speak but little English, so little, in fact, that when asked by an official whether he knew the language, he could only reply, "A few." As Dr. Steinmetz often related, he did not possess the ten dollars necessary for a safe landing, and from his appearance it did not seem likely to the officials that he would ever be capable of earning such a sum if he was allowed to land. The necessary funds were ultimately found, however, by his friend Asmussen, and a fortnight later Steinmetz presented a letter of introduction to Rudolf Eickemeyer, who gave him employment in his works as a draughtsman. From Eickemeyer Steinmetz subsequently received much encouragement in connection with his researches on magnetic material.

At the time Steinmetz joined Eickemeyer a great variety of work, ranging from the manufacture of hat-making machinery to the construction of traction and elevator motors, was being carried out in the Eickemeyer factory, and the new draughtsman was frequently called upon to assist in the solution of fresh problems. For about eight months Steinmetz worked in the drawing-office, but about March, 1890, he began to specialise in the testing of magnetic material. To enable this work to be properly carried out Eickemeyer leased a room adjoining the factory. Steinmetz was placed in charge of the laboratory and was given an assistant, who was a man skilled in the hat-making machinery business, and was liable to be called away at a moment's notice to investigate and remedy troubles. Eickemeyer was a disciplinarian, and when ill-health did not keep him away from the factory, the office and factory staff had rather a harassing time. In the testing laboratory, however, the relations were quite different; for



DR. STEINMETZ

Eickemeyer would sit and talk with Steinmetz by the hour. The two men spent a great deal of time together, both in the laboratory and at Eickemeyer's home, for they were both keenly interested in the magnetic properties of iron.

About this time a more thorough understanding of these properties was badly needed by alternating-current designers. They had, of course, access to the published tables of Ewing, but these tables failed to give the designers hard facts on the subdivision of losses into eddy current and hysteresis losses, and the variations in lost watts to be allowed for as the result of a change in the material, frequency or density. Late in the summer of 1890 Steinmetz and Eickemeyer were engaged on the design of the single-phase commutator motor, with a compensating winding, which was Eickemeyer's best known contribution to the electrical store house. Both men realised the limitations imposed upon them by groping in the dark. Steinmetz took all the Ewing results he could lay hands on, and subjected them to very critical examination. He suspected that he could find an exponent connecting B, the maximum number of magnetic lines, with the watts lost, and that he could discover a law which would give the dependence of the hysteresis upon the magnetisation, and, of course, he was successful.

Great as the subsequent work of Dr. Steinmetz was, his first step towards eminence was the establishment of this fundamental law of magnetism, a law which, although empirical, proved of considerable value to electrical engineers. This investigation lasted through the autumn of 1890. Particulars of the work were published, in the first instance in one of the electrical journals, but subsequently further tests were made with every sample of iron that could be obtained, and the results of these tests were embodied in a two-part paper which was read before the American Institute of Electrical Engineers. This paper is to be regarded as the starting point in Dr. Steinmetz's distinguished career, although it does not in any sense represent the most important work which he carried out.

In 1893 he was appointed consulting engineer to the American General Electric Company, whilst in 1902 he also became Professor of electro-physics at the Union University, New York, where the degree of Ph.D. was conferred upon him. He was also an M.A. of Harvard. His electrical researches were embodied in a series of books published between 1897 and 1917, and in many papers. He was a past President of the American Institute of Electrical Engineers and the Illuminating Engineering Society at Schenectady, where he had a private laboratory, and where he took part in local educational and administrative affairs. Steinmetz was a great advocate of electric power, and recommended the development in the United States of a national electricity supply under Federal control. During the latter part of his life he seems to have taken a keen interest in high voltage phenomena. His death, at the comparatively early age of fifty-eight, will undoubtedly be regretted by all electrical engineers, and particularly by those who knew him as a friend.

DR. J. E. STEAD.

As we go to press we hear with deep regret of the death at Everdon, Coatham, Redcar, on Wednesday, of Dr. J. E. Stead, F.R.S., the famous scientist and metallurgist, in his seventy-third year. Dr. Stead was a brother of the late Mr. W. T. Stead, of the *Review of Reviews*, who lost his life in the sinking of the Titanic. He was born at Howden-on-Tyne, where his father was a Congregational minister, was educated privately, and began his industrial career as an analytical chemist under the late Mr. John Pattison, of Newcastle-on-Tyne. On the completion of his apprenticeship he was appointed chemist at the Hebburn Works of the Tharsis Sulphur and Copper Company. Shortly afterwards he became chemist to Bolckow, Vaughan and Co., Limited, at their Gorton Steelworks, Manchester, and afterwards went to the same firm's works at Middlesbrough, where he made excellent use of his opportunities to become thoroughly acquainted with iron and steel production. In 1876 Mr. Stead entered into partnership with his first employer, Mr. Pattison, and established the Middlesbrough branch of analytical chemists, under the style of Pattison and Stead. In 1905 Mr. Pattison retired, and Mr. Stead then took into partnership his chief assistant, Mr. H. Frankland, the name of the firm being retained. His standing as a chemist and metallurgist attracted to his laboratory numerous pupils, most of whom are to-day in responsible positions in some of the largest iron and steel works, not only in Great Britain but in other parts of the world. He was borough analyst for Middlesbrough, and chemist to the Cleveland Agricultural Society. He was President of the Cleveland Institute of Engineers in 1895–6, and in 1901 the Iron and Steel Institute's Bessemer Gold Medal—one of the highest distinctions in the metallurgical world—was presented to him. He was a Fellow of the Institute of Chemistry and a member of the Council of that body from 1906 to 1909. For three years he acted as examiner in iron and steel manufacture for the City and Guilds of London Institute.

Dr. Stead became interested in metallographic research in 1893, and since that time contributed to metallographical knowledge numerous and important papers. In 1903 he was elected a Fellow of the Royal Society. On the occasion of the visit of the American Institute of Mining Engineers to this country in 1906 he, along with Sir R. A. Hadfield, was elected honorary life member of the Institute in recognition of his distinguished services. He was awarded the gold medal at the last St. Louis Exhibition for a selection of photomicrographs of metal sections, and had a similar reward conferred upon him by the Franco-British Exhibition held in London. When the Iron and Steel Institute visited Leeds in 1912 the University Court of Leeds conferred upon him the honorary degree of Doctor of Science. In 1913 he received the honorary degree of Doctor of Metallurgy of the University of Sheffield, and the honorary degree of Doctor of Science of Victoria University, Manchester, was conferred upon him in 1914. In 1910 he was President of the Chemists Section of the British Association, and was a Past-president of the Iron and Steel Institute. Dr. Stead was held in the highest opinion by all who knew him, not only for his scientific qualifications, which put him in the first rank of the metallurgists of the world, but for his transparent honesty of purpose and for a charm of manner which endeared him to all with whom he came in contact.

WILLIAM G. BLIGH.

THE death of William G. Bligh, M. Inst. C.E., of Toronto, retired executive engineer of the Indian Public Works Department, occurred at Calgary, Alta., on October 16th. Mr. Bligh was born at Great Malvern in 1846. He designed and constructed some most important irrigation works in India and Burma, and his book, "The Practical Design of Irrigation Works," is a recognised text-book on the subject. He had in preparation a new and enlarged edition of it. He was a remarkable linguist, and during the war was employed by the Canadian Government in mail censorship.

Lloyd's Register of Shipping.

ANNUAL REPORT.

THE annual report of Lloyd's Register of Shipping for the year 1922-1923 has just been issued. It is too long a document to reproduce in full, and we must, therefore, content ourselves, as in previous years, with abstracting those portions of it which will prove of greatest interest to our readers. At the outset it is remarked that since the issue of the last annual report of Lloyd's Register, very little relief has been experienced from the depression of the shipbuilding industry, and no signs of early improvement are yet manifest. The causes of the situation remain unchanged, and the tonnage now afloat shows an increase of about sixteen million tons on the figures for June, 1914. It is well known, however, that the present total includes a considerable number of vessels which for various reasons are not likely to be employed even in the event of a substantial revival of trade; and in this connection it is worthy of note that during the twelve months ended June 30th, 1923, some 300 vessels, of about 625,000 tons, were broken up or dismantled, as being no longer economically efficient. Still, shipowners in general are unable to see in the near future any probability of such an increased demand for tonnage as would induce them to place orders for new vessels. Moreover, labour disputes continue to discourage shipbuilding and to delay the completion of many vessels which have been long in hand.

In these circumstances, there has necessarily been a considerable falling off in the figures of new vessels to which classes have been assigned by the Committee of Lloyd's Register during the year ended June 30th, 1923. The total amounts to 429 vessels, of 1,616,225 tons gross, a reduction of 36 per cent. on the tonnage classed during the year 1921–22. In addition, 366 vessels, of 1,318,505 tons gross, were being built at the end of June under the Special Survey of Lloyd's Register, with a view to classification in the Society's Register Book. Plans for 424 vessels, of 1,065,850 tons, were passed by the Society during the year; but although these figures show a decided increase on those for the preceding twelve months, they are still far below the average for several years prior to the war, and it cannot be confidently asserted that all the proposed vessels will actually be built.

The countries in which the majority of the 429 new vessels classed by Lloyd's Register during the year have been constructed are shown in the following statement:—

Where built.	No.	Gross tons.
Great Britain and Ireland	295	1,135,731
Italy	18	99,553
Holland	24	76,021
Germany	15	67,043
Japan	9	57,085
United States of America	16	45,114

The nationality of the principal owners of the new tonnage is more widely distributed, as indicated by the subjoined table:—

Where owned.	No.	Gross tons.
Great Britain and Ireland	249	917,042
Holland	32	189,349
Italy	17	116,781
Japan	12	77,831
British Dominions	19	54,483
France	14	36,590
Sweden	12	35,895
United States of America	16	35,617

The total tonnage of merchant vessels afloat at the end of June, 1923, holding the Society's classification amounts to 28,208,206 tons, and is the highest total yet recorded, exceeding by nearly a million tons the similar figure for last year. If to these figures be added the vessels under construction to the Society's classification on June 30th, viz.: 366 vessels, of 1,318,505 tons, it will be seen that the aggregate of shipping classed, or intended to be classed, with Lloyd's Register totals 10,317 vessels, of more than 29½ million tons gross.

Among the vessels built during the year which have received the Society's Classification are 18 exceeding 10,000 tons each, as compared with 32 falling within this category during the previous twelve months. Of these 18 vessels, 10 range from 10,000 to 14,000 tons, while the following 8 each exceed 15,000 tons, viz.:—

Name.	Gross tons.	Owners.
Franconia	20,158	Cunard S.S. Co., Ltd.
Ohio	18,940	Royal Mail Steam Packet Co.
Conte Verde	18,765	Lloyd Sabaudo Soc. Anon. per Azioni.
Mongolia	16,385	Peninsular and Oriental Steam Navigation Co.
Montclare	16,314	Canadian Pacific Railway Co.
Moldavia	16,277	Peninsular and Oriental Steam Navigation Co.
Veendam	15,450	Holland-Amerika Lijn.
Volendam	15,434	Holland-Amerika Lijn.

Steam turbines were fitted in 74 new vessels, of 603,037 tons. Of these, 15 vessels are of more than 10,000 tons each, including, with one exception, all those of over 15,000 tons classed by the Society during the past year. In all cases the turbines are used in association with reduction gearing, mostly of the double reduction type, and in one vessel—ss. Kamoi, 10,222 tons—the turbo-electric drive is employed. In the construction of 49 vessels, of 292,254 tons gross, built under the Society's survey during the year, the Isherwood system of longitudinal framing was adopted. Practically all these, viz.:—46 vessels, of 257,196 tons, are intended for the carriage of oil in bulk. Bulk oil carriers of all types of construction built to the Society's classification during the past twelve months amounted to 76 vessels, of 341,694 tons gross. While this tonnage is much lower than the corresponding figure for the previous year, it represents a very similar percentage—21 per cent., as compared with 23.8 per cent.—of the total tonnage classed during the period under review.

Vessels to the number of 123, of 782,830 tons—48.4 per cent. of the total tonnage of new vessels classed during the year—were fitted for burning oil fuel. The following table, which comprises all such vessels recorded in Lloyd's Register Book, shows the gross tonnage of vessels either originally fitted to burn oil fuel or subsequently converted for that purpose. For purposes of comparison, the figures for the year 1914 are given side by side with those for the post-war years :—

Register book.	Vessels fitted for burning oil fuel. Gross tons.
July, 1914	1,310,209
July, 1919	5,336,678
July, 1920	9,359,334
July, 1921	12,796,635
July, 1922	14,464,162
July, 1923	15,792,418

These figures include vessels which are fitted with installations for burning oil in the furnaces of their boilers, but it does not necessarily follow that all such vessels are using oil. It will be understood that a number of such installations can readily be replaced on occasion by coal-burning fittings when oil is unobtainable or when its price, compared with coal, is so great as to render its use unprofitable.

Vessels built to class during the year and fitted with oil engines numbered 41, of 164,665 tons, 21 of which were ships of over 4750 tons each, totalling 138,112 gross tons. All these vessels were fitted with engines using heavy oil.

The continued development in the use of internal combustion engines, as recorded in successive editions of Lloyd's Register Book, is shown by the following statistics :—

Recorded in Register Book.	Motor vessels. No.	Gross tons.
July, 1914	297	234,287
July, 1919	912	752,606
July, 1920	1,178	955,810
July, 1921	1,473	1,248,800
July, 1922	1,620	1,542,160
July, 1923	1,831	1,668,414

Of the 1831 motor vessels mentioned in the above table for the current year, 335 are of 1000 tons and upwards. Of these, 71 have tonnages ranging from 1000 to 1500 tons ; 52 are from 1501 to 2000 tons ; 87 are from 2001 to 4000 tons ; 65 are from 4001 to 6000 tons ; and 60 are above 6000 tons. It will, of course, be understood that a large proportion of these vessels, particularly those of small tonnage, are provided with sail power ; but it is interesting to note that about 80 per cent. of the 264 vessels which exceed 1500 tons are solely dependent on their motor engines for propulsion.

Diesel engines are fitted in 232 vessels of upwards of 1500 tons each, 62 of which are single-screw ships. The largest vessels fitted with Diesel engines are the following :—

	Gross tons.
Zoppot	9932
Glenogle	9513
Glenapp	9503
Lochgoil	9462
Glenbeg	9461
Glengarry	9460
Lochkatrine	9409
Dinteldijk	9399
Drechtdijk	9338

It is well known that among the Diesel engines already fitted the four-stroke cycle type very largely predominates in number and total horse-power ; but a considerable number of two-stroke cycle engines are already in service. At the present time there are in course of construction, under the superintendence of the Society's surveyors, 175 Diesel engines, with a total brake horse-power of about 246,000, of which 92 are of the two-stroke and 83 of the four-stroke cycle type. The engines are intended to be fitted in 69 single-screw vessels, 26 twin-screw vessels, and 1 quadruple-screw vessel, while 50 have not yet been allocated to any particular ships.

The largest of these Diesel engines under construction are two six-cylinder four-stroke cycle double-acting engines, being made by Messrs. Burmeister and Wain, of Copenhagen, for a twin-screw passenger vessel being built by Messrs. Sir W. G. Armstrong, Whitworth and Co., Limited, for the Swedish American Line. The cylinders are 33in. diameter, with 59in. stroke, and the brake horse-power is 6750 per shaft. The cylinder diameter is 3in. larger, and the horse-power greater, than those of any other Diesel engine fitted in a vessel.

The only other double-acting Diesel engine under construction is a three-cylinder two-stroke cycle engine being built by the North British Diesel Engine Works, Limited, of Glasgow. Other double-acting Diesel engines of even larger horse-power are being considered.

ators which will supply the power to the propelling motor. The generators are being made by the British Thomson-Houston Company, Limited, Rugby.

The table given below, compiled from the Society's records, is of considerable interest, as showing, for vessels built to the Society's class during the last five years, the relative proportions fitted of (1) Reciprocating steam engines ; (2) steam turbines ; and (3) motors ; and also for the same period the proportion of the tonnage built to be propelled by the medium of (*a*) coal only ; and (*b*) oil, *i.e.*, as fuel for boilers or for motors. (A number of these vessels can, of course, burn either coal or oil for steam raising.)

Figures are likewise given below of all the vessels of 100 tons gross and upwards, as recorded in the 1923–24 edition of Lloyd's Register Book, falling within the above categories, viz. :—

	Tons gross.
Total steam and motor tonnage	62,335,373
Type of engines—	
Steam reciprocating	51,775,239
Steam turbines	8,893,749
Motors	1,666,385
Fuel—	
Coal only	44,876,570
Oil, including vessels capable of burning either coal or oil	17,458,803

The following countries now recognise the Surveys and Certificates of Lloyd's Register as exempting vessels from undergoing Government inspections of various kinds, viz. :—France, Holland, Norway, Sweden, Denmark, Spain, Greece, Belgium, Portugal, Latvia, and the British Dominions. The Committee expresses itself as glad to know that the owners of vessels belonging or trading to these countries are saved much inconvenience and delay by official recognition being thus extended to the Society's Classification and Surveys.

During the last twelve months refrigerating installations were fitted, under the Society's superintendence, in 40 vessels, representing a capacity of nearly 5,000,000 cubic feet. With this addition, at the end of June, 1923, the Society's Refrigerating Machinery Certificate—Lloyd's R.M.C.—was held by 285 vessels, with approximately 60,000,000 cubic feet of insulated space. Further, there are at present under construction, or being fitted out, under the survey of the Society's surveyors, 27 vessels with refrigerating installations. Two of these vessels are being built in Australia, one in Italy, and one in Japan. During the year, the Society's surveyors have held, at loading and discharging ports, 1759 surveys on vessels fitted with refrigerating machinery.

During the year 1922–23 freeboards were assigned to 441 vessels. Under the Merchant Shipping Act, 1894, the Committee of Lloyd's Register have now assigned free boards to 23,357 vessels. The total length of chain cable tested during the year under the Anchors and Chain Cables Act, 1899, at the Public Proving Houses in Great Britain, all of which are under the superintendence of the Society, was 185,271 fathoms, in addition to which a quantity of miscellaneous chains and samples was also tested. The number of anchors proved was 3499. During the year ended June 30th, 1923, the Society's surveyors at home and abroad tested 512,288 tons of ship and boiler steel. While this figure is appreciably larger than that for the previous twelve months, it is very far below the average amount tested in a normal year, and reflects the prevalent stagnation in shipbuilding.

Twenty-three Scholarships in Naval Architecture and Marine Engineering, each tenable for three years, are maintained by the Committee of Lloyd's Register. Twenty of these are specially assigned to the Universities of Glasgow, Durham, Liverpool, Tokio and Michigan, and the Massachusetts School of Technology, Boston, U.S.A. ; while three are awarded through the Institute of Marine Engineers, London, and may be held at any approved University or other centre of advanced technical education. Application for particulars concerning the scholarships should be addressed to the Registrars or Secretaries of the various Universities and Institutions.

NEW COLD STORAGE EQUIPMENT IN LONDON. — At the invitation of the directors of the Birckfriars Cold Storage Company, Limited, Upper Thames-street, E.C. 4, we were accorded an opportunity, on Wednesday, of inspecting the new engine-room which the company has recently had built and equipped to replace its former steam-driven refrigerating plant. The new engine-room has a floor area of only 32ft. by 28ft., yet it contains three electrically-driven ammonia compressors, having a total refrigerating capacity of 300 tons per day of 24 hours. The compressors have each three single-acting cylinders, and were supplied by L. Sterne and Co., of Glasgow.

Particulars of vessels built to the Society's Classification.

Period.	Total steam and Motor tonnage classed.	Type of engines. Steam reciprocating.	Steam Turbines.	Motors.	Fuel. Coal.	Oil.
	Gross tons.	Gross tons.	Gross tons.	Gross tons.	Gross tons.	Gross tons.
1918–1919	3,760,806	2,633,370	1,051,302	75,934	2,491,213	1,269,593
1919–1920	4,186,882	2,821,031	1,286,046 (all geared)	79,805	2,111,289	2,075,593
1920–1921	3,229,188	2,373,067	754,513 (all geared)	101,608	1,260,465	1,968,723
1921–1922	2,517,513	1,420,924	870,037 (all geared)	226,552	895,032	1,622,481
1922–1923	1,610,624	842,358	603,037 (all geared)	165,229	662,565	948,059

The "Still" engines, a combination of oil and steam engines, which are being built by Scotts' Shipbuilding and Engineering Co., Limited, for a new vessel for Messrs. Alfred Holt and Co., are now nearing completion. There has been an interesting development of the use of oil engines in the cases of three vessels which are under construction by Messrs. Cammell Laird and Co., Limited, for the United Fruit Company. The actual motive power of these vessels will be electric, but Camellaird-Fullagar oil engines are to be employed to drive the electric generators which will supply the power to the propelling motor. They are direct coupled to variable speed motors, which, with the press-button control gear, are of Messrs. W. H. Allen's design. Two of the compressors have each a capacity of 75 tons, the third being of double that size. The storage capacity for frozen meat amounts to 500,000 cubic feet, and is maintained at a constant temperature of 15 deg. to 18 deg. Fah. In summer the two small compressors, or the large one by itself, provide the required amount of refrigeration, while in winter one of the smaller sets is usually sufficient. The motors are of about 200 and 100 brake horse-power, and are supplied with current from the City of London Company's mains.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE PIECEWORK SYSTEM.

SIR,—In reference to your leading article—September 14th—dealing with the system of piecework, commonly called production by results, which gives a very glowing account of the benefits to be derived by the workman that works under that system ; but it appears to me that of the various articles that have appeared in various periodicals and newspapers never put only one side—the bright side—from the masters' point of view, which always make it look as if it was a great boon to the workman, and I have read articles from such men as G. N. Barnes, who has had years of practical workshop experience, but it is quite possible that he never did an hour's piecework in his whole experience ; but yet he seems to know all about it, and so does everyone else, except those that have had to do it. It seems strange that one never gets the workman's point of view ; but it may be because your journal is an employers' mouthpiece, and the ordinary workman does not read it, and many never see it, and a great many more do not know of its existence ; so that seems a good reason. I once put it to a fellow-workman why he didn't read THE ENGINEER, and his reply was that he was not interested, as it contained nothing but engineering. But I pointed out to him that it contained many other things besides engineering ; but as he never read it he didn't know what its contents were, and I believe that is the general rule of men in the engineering trade, that THE ENGINEER is read by very few in the trade.

Now a great deal can be said for and against the piecework system. In the first place, it is quite apart from collective bargaining, and tends to create a bad feeling in the workshop by partiality shown in the distribution of the work, and the inequality of price in proportion to the work upon the various jobs in operation. Having had thirty years at the game, and having seen some very funny things happen to some of the poor piecework victims, who are working all day, week in, week out, with just their day wages, and in some shops that I have worked in 50 per cent. get nothing over their time wages, and are very often in debt, which, consequently, ends up with the sack. I have worked in numerous shops in various parts of the country, and I find but very little difference. About 10 per cent. of the men get the pick of the jobs, and they are satisfied ; that state of affairs prevails in all piecework shops. The only chance one gets of a fair price is when a new design comes along. He may, probably, get a fair deal, but if he is working on a job that has been done before and complains about the price, he is just told that so and so has done it and got his time and half on it.

Some firms have a system of balancing up every month ; others pay every week. I worked in one shop which had a system of mortgaging ; that was, if a job was finished on a Wednesday or Thursday that should have been finished on the previous Saturday, one would book on the new job several days that he hadn't worked on it—robbing Peter to pay Paul sort of a system—and when the firm fell short of work and had no more work, it very often happened that a man might work nearly a whole week for the last week and have nothing to draw, as there was no guarantee of day or time wages. I know of firms that have insisted on men working piecework, and they have accepted it thinking they could get a few shillings extra, not considering the extra wear and tear of their bodies, for that's what it means ; and after a short time of that system they have been put off and fresh men taken on to work day work, and had to do the same amount of work as was done by the pieceworker. Now, I have known several firms that have adopted that system of inflicting task work ; that is good proof that the employers are not anxious for the workman to get more money. Other shops I have worked in have certain men to put a price on a fresh job, although they have not got to do the job. That is just one of the cunning tricks of the employer ; but whoever has the job to do has to do it at the price fixed, and, as very often is the case, the price is too low to enable them that do it to get his day wages, and in many cases leaves the job, or he may give it a trial and work on it and get into debt, and if he gets a fairly paid job to follow, what he gains over the last job has to go to pay for the former. There are many more reasons against the system. It encourages one man to hide his tools, or steal tools from his fellow-workman, which is done very frequently, and some indiscreet men are apt to boast of what a good price they get for the work and pride themselves of how they bluffed the foreman, or whoever put the price on, and when a foreman has such men as that to deal with, one cannot blame him for cutting the work as fine as possible. As a foreman told me once ; that it didn't concern him whether the price was fair or not, as his position was to get the work done as cheap as possible in order to give the firm a good return for the money invested in the concern. Many firms that I know have repeatedly cut the price of work up to as much as 50 to 100 per cent., and, in some cases, 200, that the price is so low that it is thorough slavery to get a living. So much for production by results. It really means ten men doing fifteen men's work. It creates enmity and ill-feeling in the workshop, and there is no redeeming feature in the system.

London, October 16th. J. TAYLOR.

THE EMIGRATION OF WORKMEN.

SIR,—The second communication from your correspondent "Ex-Service," raises many side issues with which it is impossible adequately to deal in a letter. With your kind permission, however, I would like to make a few further comments on the subject.

The war-period Government was certainly responsible for a great deal of wholly inexcusable profiteering, and if only the workers had insisted on that form of exploitation being nipped in the bud, it is pretty clear that our troubles would be fewer and lighter to-day than is the case. Instead, the worker merely demanded excessive wages with the idea of keeping pace with excessive prices. Higher prices were, to some extent, inevitable under war conditions, and a reasonable advance in pay to meet them was justifiable. Because of the revenue which it brought in by way of the Excess Profits Duty, profiteering was largely encouraged by the Government of the day. Hence, the workers demanded more and more money, and the effect was, of course, to still further increase the cost of all necessaries. The Government was to blame in the first instance ; the workers subsequently, for being unable to foresee that the results of their higher rates of pay would ultimately recoil on themselves.

The truth is that, during the war, at any rate, the worker was often quite as much a profiteer as any capitalist.

After the Armistice, and when it became a question of the demobilised men returning to civil life and work, what did the trade unions do? They promptly prevented men from obtaining certain kinds of employment on the despicable ground that the applicants had not, before the war, been engaged in those particular industries. For this reason, many thousands of willing workers were thrown on the labour market, and now the unions complain of the large amount of unemployment that prevails! What have the unions done to help their members? What practical scheme have they put forward? What they actually have done has been to kill individual effort and incentive, and by thus checking production, in the mistaken notion that they would be hitting the capitalist, and, incidentally, helping to keep themselves in their jobs, they have achieved far more harm to the trade of this country than they would be willing publicly to acknowledge.

The better conditions obtaining in the United States are due to Protection. Free Trade is not free trade when its freedom is confined to benefiting, principally, Protectionist countries. Yet indiscriminate Free Trade is one of the planks of the Labour Party, who seemingly delight to see the cheaply made goods of other nations dumped in Great Britain, *ad lib.*, to compete against the products of our own workers. Pure and simple Protection is, of course, out of the question for Great Britain; still, one would have thought the Labour people would have consistently protested against over-dumping of, at least, manufactured articles. About twenty years ago, the Board of Trade collected statistics in the United States which went to show that, in spite of higher rents and higher prices generally, the American workman was considerably better off than the British employee, his standard of living being correspondingly much higher.

Employers did not combine to protect their interests until the growth of trade unionism compelled them to do so. If trade unionism had as its chief object the fostering and improvement of trade itself, whereby both masters and men would benefit, there would be something to be said in its favour. But when its avowed purpose, as at present, is to destroy the capitalist and get industry into its own hands, it is surely time to cry a halt. Russia affords an outstanding example of what such a mad-headed policy means from the workers' own standpoint. There you have a people stripped of every shred of liberty of action or thought; a people reduced to such a state of slavery and demoralisation as no capitalist system would, for its own sake, ever permit in these enlightened days. No workers could be more subjugated than are the Russians to-day, but the Communists will tell you that it is an ideal life, and one which the workers in all parts of the world should strive to attain.

So long as Labour entertains its present designs to confiscate other people's money, for that is what the elimination of the capitalist would come to, so long will Labour show its utter unfitness to govern. The capitalist system may be far from being perfect, but Labour's acknowledged alternative would be infinitely worse. Human nature is much the same everywhere, and there would be quite as many limpets and parasites under a Labour Government as there are under a so-called capitalist Government. Possibly, indeed, a much greater number, for personal aggrandisement would be the order of the day if Labour ruled, and in a few months many important industries would come to a complete standstill. Let "Ex-Service" ponder well over these matters.

The trouble is that every Labourite is, at heart, just as much a capitalist as the man he condemns. Moreover, all the big trade unions invest their funds in some sort of capitalist concern, or its equivalent, in order to get interest on their money, a fact which speaks for itself.

I was very pleased to see the letter sent you by Mr. William Collison, the general secretary of the National Free Labour Association, and I heartily endorse the views which he so ably expressed respecting the tyranny of trade unionism and its consequences.

October 26th. CLYDE ENGINEER.

NATIONAL PROFIT SHARING.

SIR,—I notice with interest the comments you make in your issue of the 26th inst. on the national profit sharing scheme in industry, which I ventured to suggest at the annual conference of Scottish Savings Workers in Glasgow recently. In these critical times, it is a pity that adverse criticisms should be advanced without any suggestion of a satisfactory alternative.

Taking your points in order, I would remark:

(1) While the machinery necessary to carry out the scheme might, in pre-war days, have been considered unwieldy, since then, however, in view of the numerous returns that have been called for from industrial establishments by the different Government Departments, the simple record of each man's hours worked and his rate for, say, each six months, and giving a copy of same to the worker and to the Post Office, would not seem to be imposing a very severe extra burden on clerical staffs, and such would, I think, be well worth almost any trouble if it resulted in the desired co-operative effort.

(2) Why you should fear that such a scheme might be the basis of "much labour trouble," I cannot understand without specific examples being given. Any fair scheme tending to produce greater harmony and co-operation between employers and employed should be looked upon with favour rather than suspicion by trades unions.

(3) As regards the penalising of the well-managed firm for the sake of the badly managed concern, this also seems to me to have little foundation when the factors which contribute to success in industries are carefully analysed. It is possible to have an efficiently managed industry, with up-to-date plant, which, from other causes beyond control, may be unsuccessful from a financial point of view. Dividend earning may be due to other factors than efficiency, as, for instance, the obtaining of highly remunerative prices due to, say, a monopoly, or to a very large demand for products with large output, quite possibly, uneconomically produced. The financial success of a business may also be largely accounted for by the management being carried out on a strictly business footing, which may result in the prompt suspension or discharge of all unnecessary members of the staff and workpeople the moment these are not required, thus throwing as much as possible of the burden of unemployment on the State.

Taking all these factors into consideration, therefore, the financially prosperous concern may, in fact, often be thus fortunate as much from good luck as from good guidance, and, in any case, should contribute to the national industrial fund.

If such a scheme as I have suggested could be successfully operated, there might follow natural extensions embracing railway, municipal and Post Office workers, &c., such concerns being required to pay to their employees a similar dividend to that declared under the national profit sharing scheme. This would, I think, have the effect of creating in those employees also an interest in the well-being of industry, in which all workers should be concerned, this being the basis of true national prosperity.

I have to thank you for the notice you have taken in your paper of the proposed scheme.

Glasgow, October 30th. HUGH REID.

PATENTS FOR INVENTIONS.

SIR,—I do not propose to take up your space by discussing at length your article on patents for inventions, but I desire to point out that several of the statements in the article are not founded on fact.

You state that "Had Watt not held his patent of 1769, a score of firms would, in his day, have built steam engines for every one that did so." Now, what are the facts? On getting his patent, Watt did everything in his power to push the invention with the aid of capital provided by his friends, but all in vain, until the ruin of one of his friends brought Boulton into the business. Now, Boulton was a man of great energy and considerable means, and he also did his best; but, nevertheless, the position in 1782 was as thus described by Smiles in his "Lives of the Engineers":—"Thirteen years had passed since the original patent had been taken out and seven years since the Act had been passed for its extension. But the engine had, as yet, yielded no profit, and the outlay of capital continued. Notwithstanding Boulton's energy and resources, the partners were often in the greatest straits for money, and sometimes, as Saturday nights came round, they had to beat about among their friends for the means of paying their workmen's wages." Now Boulton and Watt had the security of the patent; indeed, Boulton refused to advance capital until it was prolonged. In view of these facts, it is not easy to believe in the existence of twenty firms willing to take up the business without the security of the patent.

Again, your article goes on to say that "had Trevithick been more careful in the protection of his inventions, the progress of the high-pressure engine would have been much slower than it was." Now, Trevithick was not the inventor of the high-pressure steam engine; it was suggested as far back as 1769 by Watt, and I do not think that he was the first—nor was Trevithick the first—to use the high-pressure engine as a locomotive. Murdock was before him, and, lastly, Trevithick took out a patent for his engine in 1802.

Your article next asks: "Does anyone suppose that electrical engineering would have advanced more rapidly than it has done had Faraday patented his discoveries?" Now, I think it is certain that electrical engineering would not have been in any way hampered if Faraday had patented all of his discoveries, for I do not believe that any one of them came into commercial use within fourteen years. I will go further and say that the world would, in all probability, have had the dynamo many years sooner if Faraday had devoted his genius and his time to the practical uses of his discoveries and had been fortunate enough to find a capitalist to provide the necessary funds and do the commercial part of the business.

You quote Lord Armstrong's remarks on the uselessness of patents, but you omit to point out that he afterwards modified his views, and that during his lifetime numerous patents were taken out by his firm. You state that there are annually taken out "many hundreds, possibly thousands" of blocking patents, and "hundreds, possibly thousands" of patents which are not anticipated by British specifications, but are anticipated by other publications. I can only say that I do not believe these statements, for they are entirely contrary to my experience as a patent agent for more than forty years.

In conclusion, I would say that my views are in no way influenced by the question of fees, for I retired from practice eight years ago.

London, S.E., October 29th. EDWARD CARPMAEL.

[It would take us too far to discuss the points raised by Mr. Edward Carpmael, but as he has quoted Smiles we may reply with another quotation from that author. "There is no doubt that the public would have benefited by Watt's invention being made free to all who wished to use it" ("Boulton and Watt," page 179).—ED, THE E.]

SIR,—I beg to write that I have read your leading article on patenting inventions in your last issue, with interest. I regret, however, that no kindly reference is made to the poor inventor—one who is not in the favourable position in life to "give" his (or her) ideas, &c., for the love of trying to help the community at large.

I would at once state that unless an invention—good or bad—is fully patented, that it is useless for him to expect any due recognition accruing therefrom. And, let me state, that quite good inventions have been got out by men in humble life, but only when money has been at the back of their device.

I could make out specifications of about six good inventions and illustrate same by drawings, several of which I am positive, as an intelligent observer, that they are badly needed. Some capitalist, or an inventive man with "means," will, sooner or later, have the benefit of what I already know; but, of course, he will be known as the first and true inventor. One of my inventions on the market used to be advertised by an engineering firm in your journal, 1910–13.

London, S.E., October 29th. J. W. FUSSELL.

SIR,—In your interesting leader of October 26th on the above subject, there does not appear to be much encouragement for the inventor. After paying the enormous fees, and supposing he is fortunate enough to sell same, then he is liable, under the head of unearned increment, to pay Income Tax, and this also applies to royalties. As those who are fortunate enough to win a lottery or sweepstake are exempt from Income Tax, I consider the same ought to be granted to inventors, who are more of benefactors to the country than people who win money just by chance. A certain Labour member said: "Inventors ought to give their ideas to the nation gratis," but this member puts aside how inventions, especially mechanical, benefit labour in the end.

October 28th. STRADIUM.

THE PRODUCTION OF PROCESS STEAM.

SIR,—As a reader of your paper for many years, I have frequently found most interesting information, much of which is very helpful on various matters. I should be extremely obliged if you could find room to publish the following inquiry with a view to getting the opinions of a few readers.

As the chief engineer of a large factory, the process of which consists largely of evaporating under vacuo, I generate steam on six Lancashire boilers at 80 lb. pressure, with an evaporation per boiler of 800 to 1000 gallons per hour. The steam is passed through a main to reducing valves, and reduced down to 25 lb. to 30 lb. pressure—we, of course, require a large volume of steam at 80 lb. for other purposes. My view is that if half the number of boilers were arranged so that steam was generated at, say, 40 lb. pressure, and was reduced down to the 25 lb., a considerable saving of coal should be effected, and at the same time retain the heat units in the steam at 25 lb. pressure as when reduced down from 80 lb. At present we evaporate about 8 lb. to 8.5 lb. of water per pound of coal from and at 212 deg. Fah.

These figures I consider very satisfactory, but I believe losses are made in the large amount of reduction required from 80 lb. to 25 lb. pressure. I should be glad to have the views of any interested readers on the above matter.

This, no doubt, will be of interest to many maintenance engineers.

October 18th. E. C. H.

CATALOGUES.

FREDERICK PRATT, 60, Victoria-street, London, S.W. 1.—Illustrated leaflets giving prices of glass shades for electric light fittings.

CHARLES CHURCHILL AND CO., Limited, 9-15, Leonard-street, London, E.C. 2.—Illustrated folder describing the "Invincible" die-casting machine.

MERRYWEATHER AND SONS, Limited, Greenwich-road, London, S.E. 10.—Pamphlets No. 33c, No. 97d, and No. 101d, concerned with various types of hose.

THE BRITISH MANNESMANN TUBE COMPANY, Limited, 67, Queen Victoria-street, London, E.C. 4.—Illustrated pamphlet dealing with lap-welded steel pipes up to 72in. in diameter.

J. STONE AND CO., Limited, Deptford, London, S.E. 14.—Illustrated catalogue on the Suntube pumps. The firm will forward copies of this catalogue to all interested engineers.

BELLISS AND MORCOM, Limited, Birmingham.—Pamphlet L, illustrated dissertation on "The Production of Cheap Power in Conjunction with Heating and Drying by Exhaust Steam."

THOS. HILL-JONES, Limited, Invicta Works, Bow Common-lane, London, E. 3.—Brochure with numerous illustrations depicting roads made with various kinds of "Invicta" bituminous materials.

A. G. MUMFORD, Limited, Culver-street Engineering Works, Colchester.—A well-bound artistic booklet, descriptive of the firm's specialities, including steam and electric pumps marine steam and oil engines, boilers, feed regulators and auxiliary machinery.

ROBEY AND CO., Limited, Lincoln.—Pamphlet containing illustrations of a selection of the firm's products; also Publication No. 379/1923, giving illustrations and particulars of vertical high-speed air compressors; also Catalogue No. 8380, giving illustrations and particulars of horizontal and vertical steam engines, uniflow engines, steam and electric winding engines, oil engines, air compressors, locomotive and vertical boilers, steam wagons, traction engines, tractors, road rollers, stone breakers, &c.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

WE are asked to announce that Messrs. S. Thomas Pemberton and Co., of 8, Church-street, Colmore-row, Birmingham, will in future represent United Water Softeners, Limited, of Kingsway, London, in the Midlands area.

MARSHALL, SONS AND CO., Limited, Engineers, Gainsborough, inform us that the address of their representative in the North Midlands, Mr. Eric E. Spencer, is now 450, East Park-road, Leicester. Telegrams: "Thrasher," Leicester. Telephone: 1386.

W. H. WILLCOX AND CO., of 38, Southwark-street, London, S.E. 1, ask us to announce that they have just secured registration of new telegraphic and cable addresses, as follows:—Telegrams: "Enginsplys, Boroh, London"; and cables: "Enginsplys, London."

THE BRITISH CHILLED IRON AND STEEL COMPANY, Limited, asks us to state that it has purchased the business of the British Griffin Chilled Iron and Steel Company, Limited, and intends to operate the works at Barrow-in-Furness on lines similar to those previously carried on by the latter company.

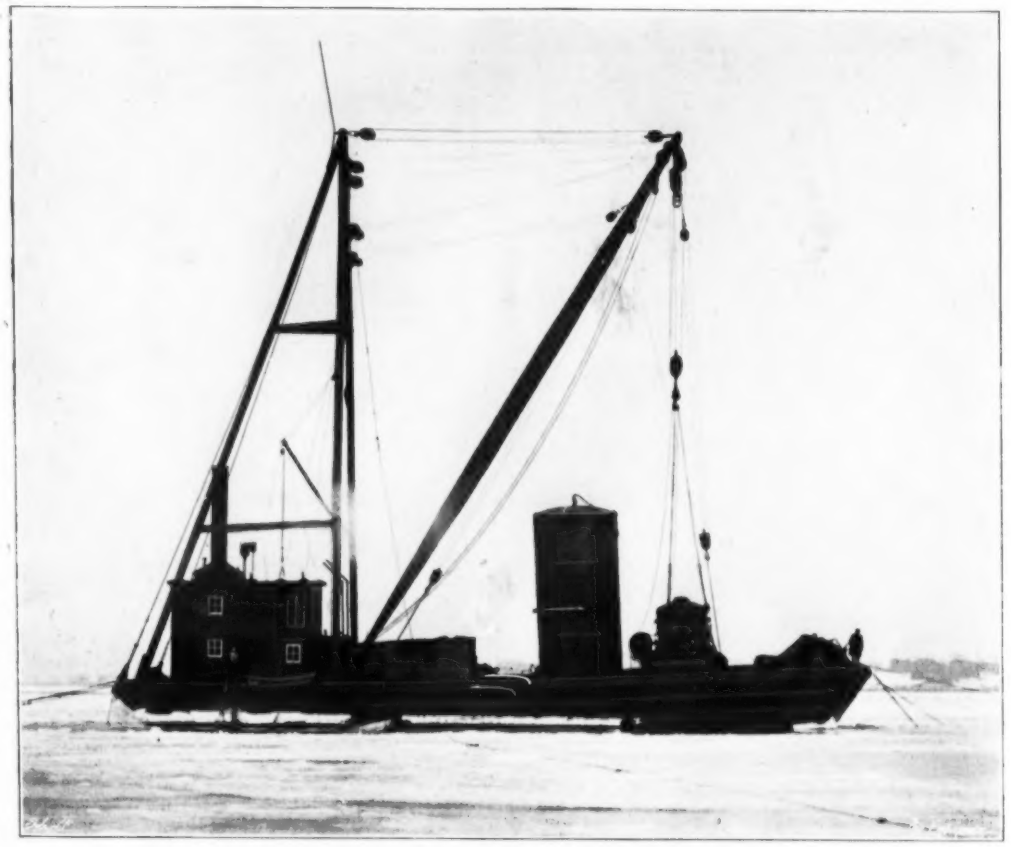
CLARKE, CHAPMAN AND CO., Limited, of Victoria Works, Gateshead-on-Tyne, have removed their London office from 50, Fenchurch-street, to 116, Fenchurch-street, E.C. 3. Their telephone number remains the same, viz., Avenue 4251, and their telegraphic address is still "Cyclops, Fen., London."

INSTITUTE OF METALS: LECTURE ON AMERICAN METALLURGY.—Dr. W. Rosenhain, F.R.S., is to lecture before the Institute of Metals, London Local Section, on "Some Impressions of American Non-ferrous Metallurgy," on Thursday, November 8th. Invitations to the lecture may be obtained by sending a stamped and addressed envelope to the hon secretary of the Local Section, Miss K. E. Bingham, M.Sc., the National Physical Laboratory, Teddington, Middlesex.

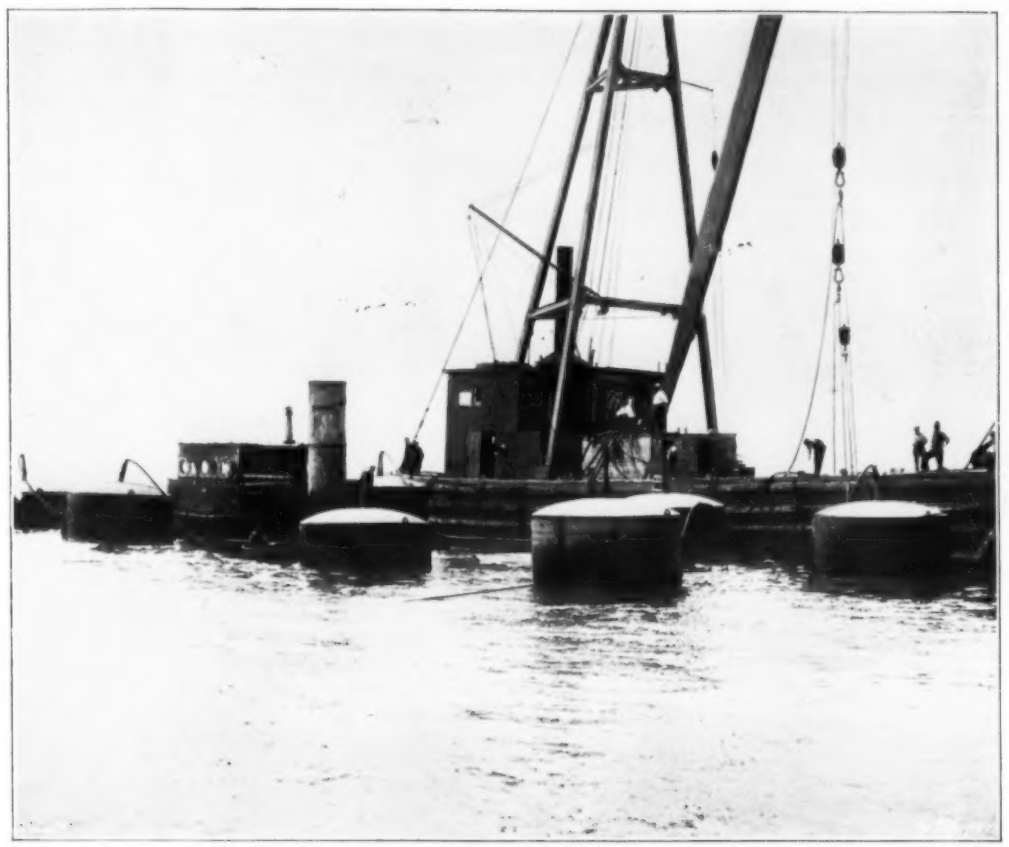
THE JUNIOR INSTITUTION OF ENGINEERS.—We are asked to state that Sir J. Fortescue Flannery has accepted the invitation of the Council of the Junior Institution of Engineers to become president of that Institution in succession to Captain H. Riall Sankey. Sir Fortescue's induction will take place at a meeting to be held at the Royal Society of Arts on Friday, December 7th, when he will deliver his presidential address, "Marine Propulsion During Fifty Years." Tickets for the meeting, which commences at 7.30 p.m., may be obtained from the secretary of the Institution, 39, Victoria-street.

SCHOLARSHIPS IN NAVAL ARCHITECTURE AND MARINE ENGINEERING.—The following scholarships in naval architecture and marine engineering have been awarded by the Council of the Institution of Naval Architects:—Naval architecture: Vickers Scholarship (£150 per annum for three years), to Mr. C. J. C. Bateson, of Vickers, Barrow-in-Furness; Hawthorn-Leslie Scholarship (£150 per annum for three years), to Mr. John Robson, of Hawthorn, Leslie and Co., Hebburn-on-Tyne: J. S. White Scholarship (£100 per annum for three years), to Mr. Thomas Hamilton, of the Fairfield Shipbuilding and Engineering Company, Govan; Denny Scholarship (£75 per annum for three years), to Mr. Bryce Crawford, of Dumbarton. Marine engineering: Richardson-Westgarth Scholarship (£150 per annum for three years), to Mr. Thomas B. Hall, of Richardson, Westgarth and Co., Hartlepool.

THE RENO MARINE SALVAGE SYSTEM.



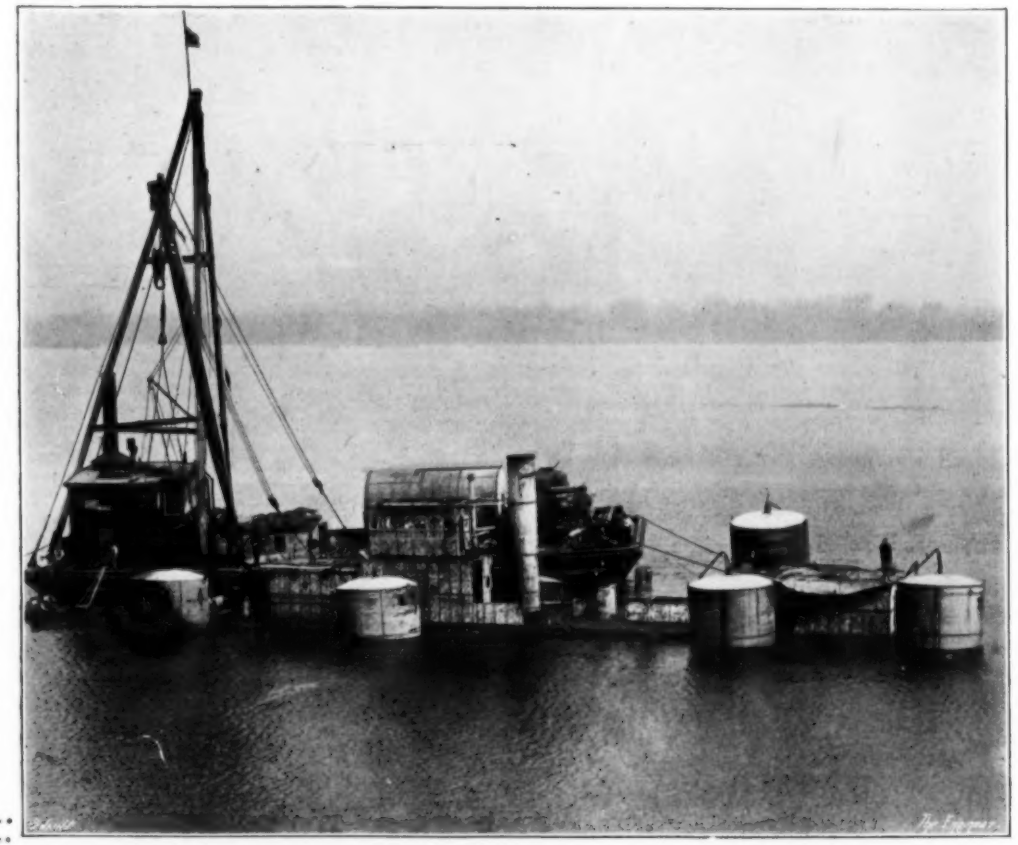
BEGINNING OPERATIONS—LIGHTER WITH TRACTOR AND PONTOON



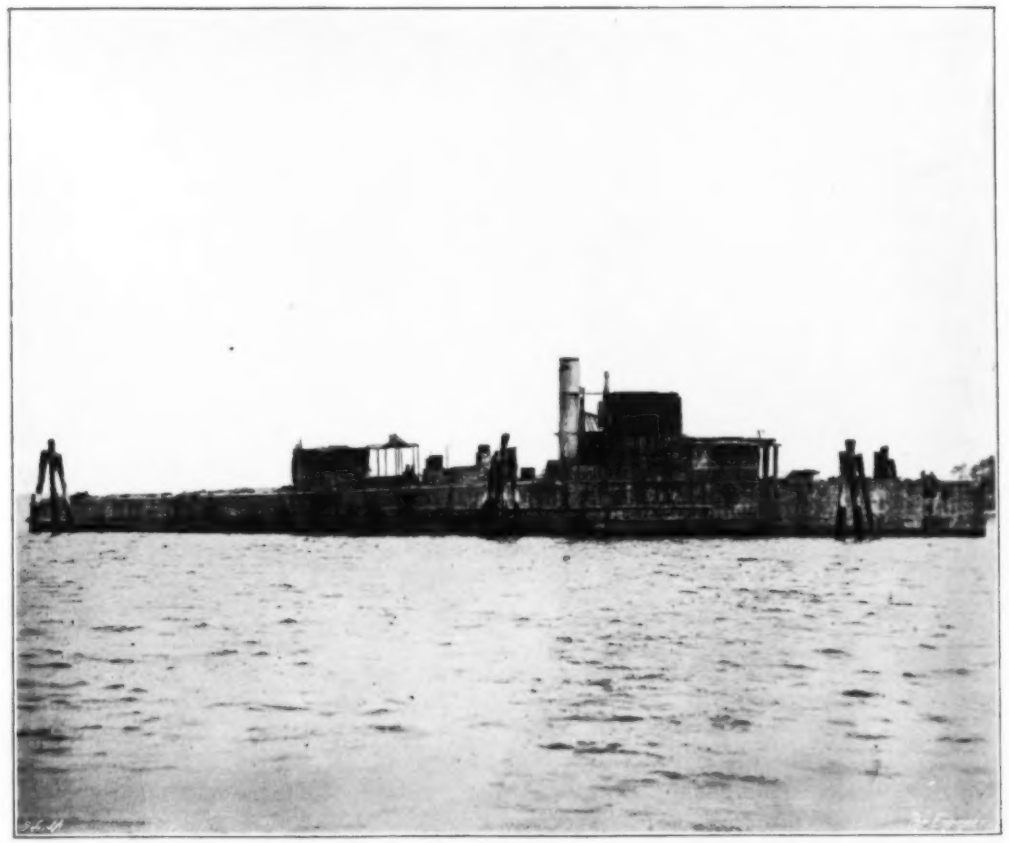
S.S. SCALLY RAISED BY PONTOONS INTO THE FIRST POSITION

END VIEW OF SHIP SHOWING POSITION OF PONTOONS

THE RAISED VESSEL GROUNDED AT HIGH TIDE



BEACHED READY FOR PLUGGING AND PUMPING OUT



S.S. SCALLY PUMPED OUT AND RE-FLOATED

The Twin-screw Motor Tanker Arnus.

On Tuesday last, the 30th ult., we had the pleasure of inspecting the new twin-screw motor tanker Arnus, which has been built and engined by Swan, Hunter and Wigham Richardson, Limited, at their Neptune Works, Newcastle-on-Tyne, to the order of the Compañia General de Tabacos de Filipinas, of Spain. She is of interest because she represents the builder's post-war practice with regard to oil tankers fitted with internal combustion engines of the Neptune two-cycle type. Fig. 1 shows a view of the ship taken on trial. She has a length of about 377ft., a breadth of 49ft., and a moulded depth of 28ft. 9in. With a gross tonnage of 4185 tons and a net tonnage of 2548 tons, her deadweight carrying capacity is about 6400 tons on a draught of 23ft. 3in. The hull is of steel, and conforms to the highest class of Lloyd's Register. It is designed to carry light and heavy oils in bulk, and fourteen hold tanks, besides summer tanks, are provided. Forward of the cargo oil tanks there is a hold, arranged for the reception of ordinary cargo. This hold has a capacity of 5700 tons at 49 cubic feet per ton, and in it is placed a deep tank in which either oil fuel or water ballast may be carried.

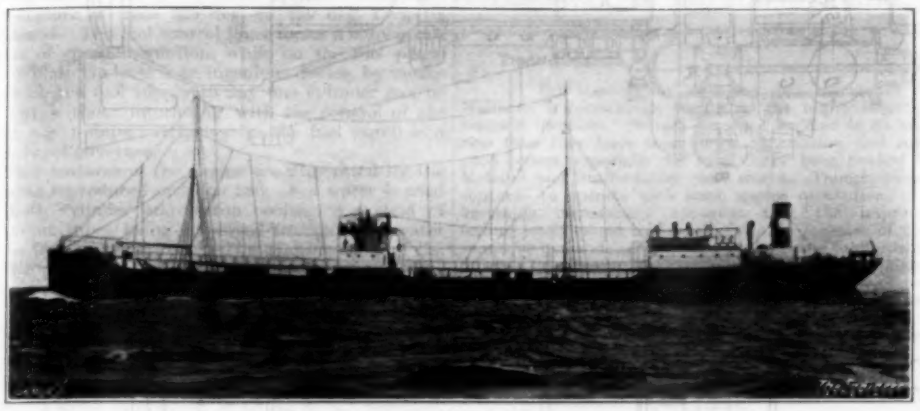


FIG. 1—THE TWIN-SCREW MOTOR TANKER ARNUS

In addition to this deep tank, ample provision is made for water ballast, both in the fore and after peaks, while below the machinery the double bottom space is constructed so that, if desired, oil fuel may be carried in it. In addition to the spaces we have already mentioned, there are oil fuel bunkers forward of the engine-room, having a capacity of 570 tons at 39 cubic feet per ton.

The accommodation for the officers and crew is good and well arranged. On the upper bridge there is the captain's room, the wireless and chart room, and below the bridge in a deck house is the dining saloon and the state rooms for the deck officers. The crew and petty officers are provided for in the forecastle, while the engineers' quarters are right aft, in close proximity to the engine-room, their rooms being on the poop deck. No firemen are carried on the vessel, and the greasers are accommodated below the poop deck.

For reasons given later, the deck machinery is steam driven, and comprises a steam windlass and two steam winches, the steam being supplied from the oil-fired donkey boiler placed aft. An exception to this arrangement is the steering gear, which is of the Hele-Shaw hydro-electric type. Two lifeboats and a working boat are carried, and the usual wireless installation is fitted.

The Neptune Two-cycle Engine.

Swan, Hunter and Wigham Richardson have been for some years builders of the two-cycle Diesel engine, and in The Engineer of May 29th, 1914, we described the four-cylinder engines of the motor ship Arum, which were built by them under a licence of the Atlas Diesel Company, Limited, of Stockholm. The new Neptune engine, as installed in the Arnus, works on a similar principle, but the modifications and improvements in design which have been made constitute practically a new type of engine. On page 486 we give a sectional drawing of the engine, and on Fig. 2 a photograph of one of the units on the test bed is reproduced. Each of the two engines is designed to develop 1400 indicated horse-power at a propeller speed of about 112 revolutions per minute. Power is developed in six cylinders, with a diameter of 17in. and a stroke of 35in. The general lines of the design give a clean engine of robust proportions. As will be seen from the right-hand view of the drawing reproduced on page 486, the cylinders are supported on substantial cast iron columns, which carry the crosshead guides, and, in addition, heavy bolts are taken through from the bed-plate to the tops of the cylinders. The idea of providing a scavenging cylinder immediately below the working cylinder has been retained, an arrangement which, it is claimed, obviates the necessity of introducing cold air into the main cylinders when starting and manœuvring, since the scavenge cylinders are used for starting. It also simplifies considerably the construction of the cylinder cover. Apart from a small automatic escape valve, the fuel valve is the only valve in the cylinder cover—see Fig. 3. A very neat design of cylinder cover has been adopted, and one, we believe, which should go far to remove undesirable heat stresses in the metal immediately surrounding the combustion space. The inner part of the main cover will be seen to contain a central liner of conical form, the bottom half of which surrounds the symmetrical piston crown. Into the top part of this liner there is fitted a smaller cover carrying the fuel and escape valves, the latter being controlled and operated from the working platform. Below the working cylinder, and slightly larger than it in diameter, will be seen the scavenging cylinder, which is designed to deliver scavenge air to the main cylinders at a pressure of about 1¼ lb. per square inch. The air is delivered from the scavenging cylinders into three vertical receivers C, each of which is furnished with a piston valve A, actuated by an excentric on the top cam shaft by means of a rod. The function of this valve is to control ports which admit air from the atmosphere to the inlet ports of the scavenging cylinder and other ports which transfer the compressed air delivered by the scavenging cylinder to the main cylinders through short connecting pipes D and rising mains connected to the four scavenge ports in each of the main cylinders. Attached to the receiver C is also a change-over valve B, which is connected to the starting receivers. By moving this valve, the connection with the atmospheric air is cut off and starting air admitted through the valve F. The parts marked E indicate the air inlet ports for atmospheric air.

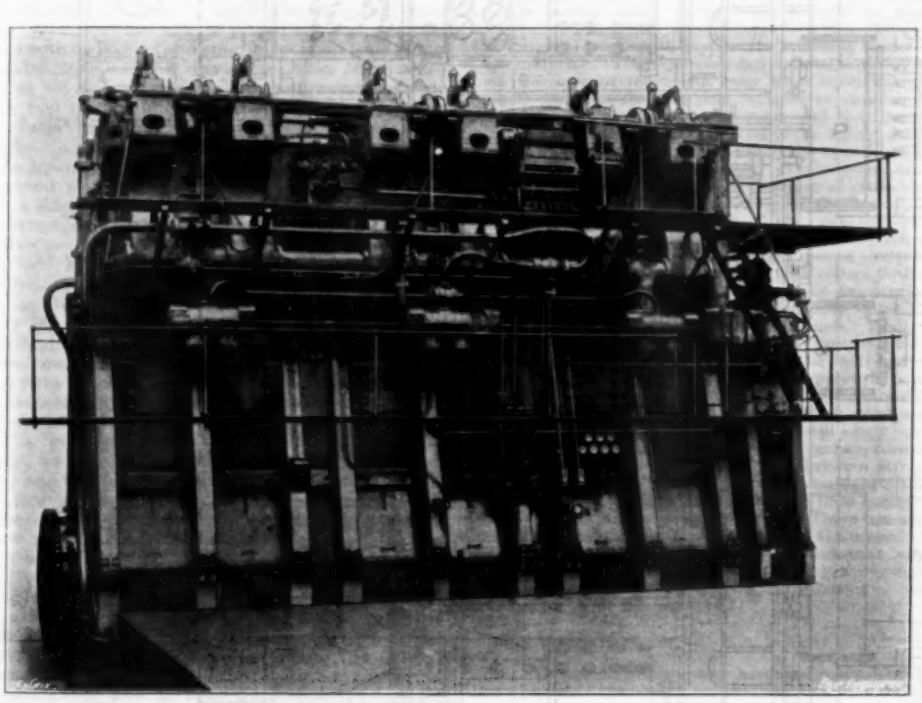


FIG. 2—1400-I.H.P. NEPTUNE TWO-CYCLE MARINE OIL ENGINE

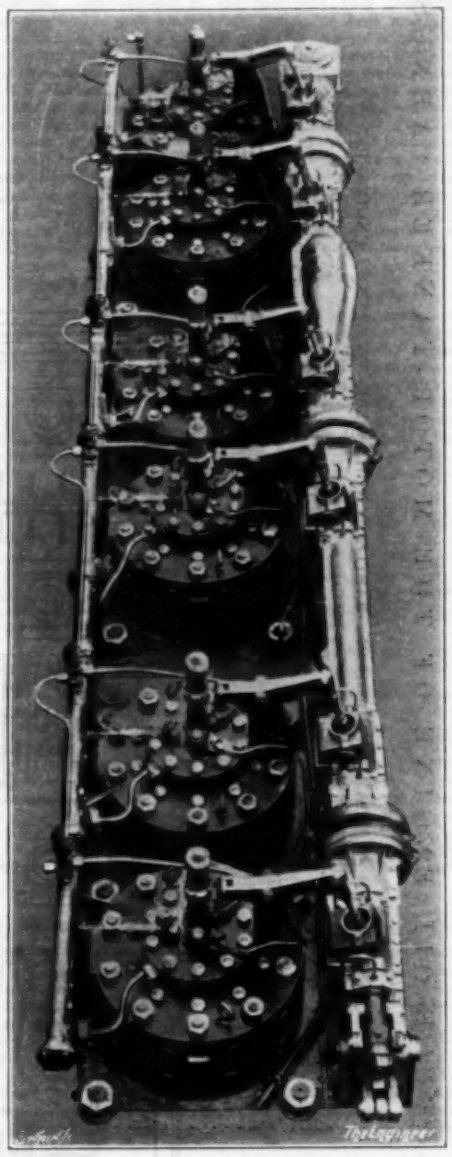
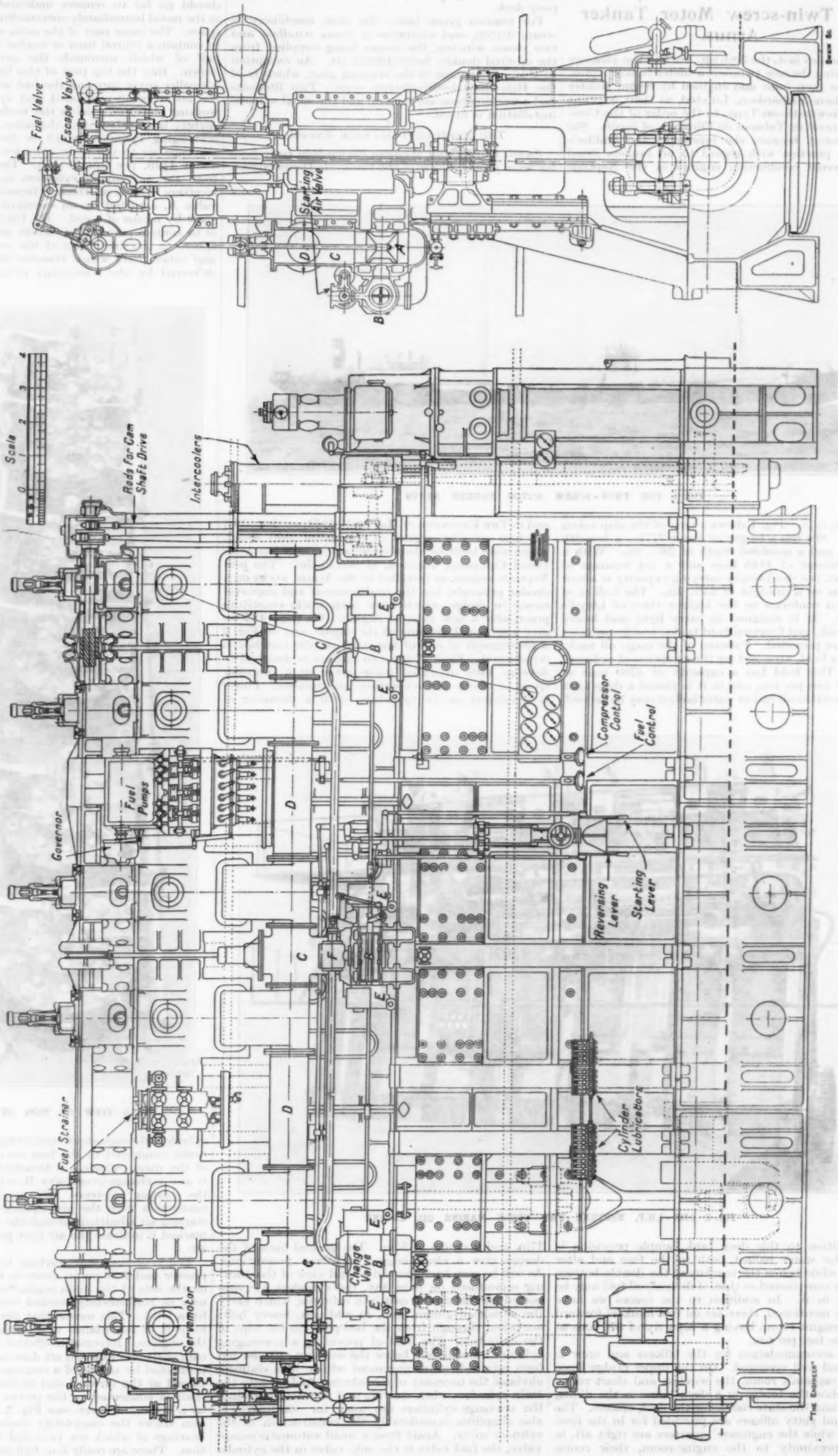


FIG. 3—VIEW OF TOPS OF CYLINDERS

The reversing and starting levers and the compressor and fuel pump controls are neatly arranged on the side of the main engine column, so that they may be conveniently worked from the bottom platform level. This means that the main control platform is in accordance with usual practice, between the engines. Reversal is effected by sliding the main cam shaft in a fore and aft direction, which operation is effected by means of a compressed air servo-motor placed at the forward end of the engine. The cam shaft is connected to the piston of the servo-motor by a bell-crank lever—see Fig. 3. The same illustration shows the completely enclosed cam shaft, the bearings of which are provided with forced lubrication. There are really four fuel cams to each cylinder, for in addition to the usual ahead and astern cams,

TWO-CYCLE OIL ENGINE OF THE MOTOR-TANKER "ARNUS."

SWAN, HUNTER, AND WIGHAM RICHARDSON, LIMITED, NEWCASTLE-ON-TYNE, ENGINEERS



a further pair is provided alongside them, so that the engine may be run at a reduced speed with a smaller fuel valve lift. The position of the shaft relative to the cams is indicated by the four gates of the rack through which the reversing lever is moved. Adjacent to this lever is the starting lever, which closes the air inlets E of the change-over valves and admits low-pressure starting air to the scavenging cylinders through the air starting valves and pipes F.

Quick response was made to the telegraph orders, and we noted that reversal from full ahead to full astern was carried through in 15 sec., and that the time taken from stop to full speed ahead was 7 sec. A Cambridge pyrometer is fitted for the purpose of recording the temperatures of the exhaust gases, leaving each cylinder, and under normal conditions a temperature of from 225 deg. to 250 deg. Cent. is registered. The fuel control lever forms a convenient means of speed regulation, while on the fuel pump at top platform level is an ingenious device, by means of which the fuel supply to any one cylinder can be cut out without interfering with the control of the other fuel pumps. Attached to the fuel pump is a centrifugal governor.

Other features of the engine are illustrated by the drawing reproduced on page 286. Sea water is used for both cylinder and piston cooling, a system of telescopic tubes being employed to carry the water to the hollow piston-rods. The compressor is of the builder's own design, and is of the three-stage type, directly driven from the crank shaft at the after end of the engine. The intercoolers are placed alongside it, and are of the vertical tube type with large cooling area. Immediately behind the compressor will be seen the two sets of cranks and excentrics which drive the cam shaft through an intermediate lay shaft. Forced lubrication is fitted to all bearings, and the working and compressor cylinders are served by a series of mechanically operated sight-feed lubricators actuated by rods connected to the lay shaft of the cam shaft driving gear. Right aft of the engine is a turning gear—not shown—arranged for compressed air and hand operation.

Auxiliary Machinery and Trial Results.

In designing this tanker the question of the auxiliary machinery was carefully considered by the builders, and the consulting engineers, Flannery, Baggallay and Johnson, Ltd., of 9, Fenchurch-street, E.C., under whose superintendence the ship was built. As cargo oil pumps of the Weir steam type were adopted, it was decided to make the whole of the deck machinery steam driven, and also part of the engine-room auxiliaries. A boiler, 10ft. 6in. in diameter and 11ft. 6in. long, oil fired on the Wallsend system with Howden's forced draught, is placed aft, and steam is raised both on leaving and entering port. Steam being available, it is used for driving an Allen 55-kilowatt lighting set and for one auxiliary compressor, as well as for fuel heating and for the Weir 20 tons per day evaporator and the Hocking 1000-gallon per day distiller.

The main electrical generating plant is placed aft at second platform level, and comprises two Sulzer R.V. solid injection oil engines, driving 55-kilowatt generators, while the switchboards and 12-kilowatt lighting generator set, also the workshop motor, were supplied by the Metropolitan-Vickers Company, Limited. Sulzer auxiliary compressors, one electrically and one steam driven, are installed, each designed to deliver 90 cubic feet per min. of free air, compressed to 1000 lb. per square inch. An interesting auxiliary is the emergency compressor generator, built by the same firm, which is driven by a hot bulb engine. The generator is an 8-kilowatt machine, and the compressor is designed to compress 70 cubic feet of free air to 1000 lb. per square inch per minute. Among the pumps, we noted a Drysdale 110-ton per hour ballast pump and two piston cooling water circulating pumps and two jacket cooling water pumps by the same makers. Each piston pump is designed for a 10,000-gallon per hour duty, while the jacket pumps are rated at double that amount. The lubricating oil pumps, which are also two in number, are by the Rotoplunge Pump Company, and two similar pumps are used for fuel transfer, the former being rated at 3600 gallons per hour, and the latter at 12 tons per hour. Bilge and general service pumps, by Clarke, Chapman and Co., Limited, are installed, each with a capacity of 30 tons per hour, while there is a forward oil fuel pump by the same makers and a forward ballast pump by Lamont. A 600 square foot Neptune auxiliary condenser and two Hayward-Tyler feed pumps of 3800 gallons per hour capacity are provided, and for the lubricating oil service there are oil coolers by the Serck Radiator Company, Limited, and a De Laval purifier.

Throughout the trial the engines ran well, with a pleasing absence of noise and vibration. The fuel used was Mexican oil of 0.94 specific gravity, and only a faint exhaust was noted. Previous trials at sea had been made, and with ballast trim a speed of over 11¼ knots was attained, and a speed of 10¾ knots was maintained for nine hours, with the ship in fully loaded condition. Slow-speed trials showed that satisfactory running at 20 revolutions per minute could be carried out. It is estimated that the total fuel consumption at 10 knots in fully loaded service conditions will be about 7¼ tons per day. Although this is the first oil tanker of the type to be built since the war, Swan, Hunter and Wigham Richardson are fortunate in having several other similar ships, mostly single-screw vessels, on hand. At the present time there are going through the shops seven Neptune oil engines, ranging from 1250 up to 3200 equivalent indicated steam horse-power. In the larger engines, we understand that the scavenging air will be supplied by special pumps, and some interesting modifications in design will be made.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Trade Situation.

The tone of the iron and steel market in the Midlands is increasingly bright as the improvement in business increases. Buyers are more inclined to do business than they have been for many months, and some good orders, especially for steel, have been booked by Midland and Staffordshire steel works. Though buyers continue to operate with some degree of caution, it is becoming increasingly apparent that the improved feeling lately noted is supported by an increase of consumptive demand. The general state of the Staffordshire finished iron trade, however, is only moderate. Manufacturers are not unhopeful, particularly in view of projected schemes and the prospect of Government and railway work being released. Values of raw iron and of steel are in the ascendant and prices are more uniform than they have been for some time.

Raw Iron Prices Advanced.

Midland smelters, as anticipated, followed the lead of Cleveland blast-furnace owners and advanced their prices by from half-a-crown to as much as five shillings per ton. On 'Change in Birmingham to-day—Thursday—the minimum quotation for Derbyshire No. 3 foundry pig was £4 12s. 6d. at furnaces. Northamptonshire makes were quoted at a similar figure. Derbyshire forge iron was quoted £4 4s. and £4 5s. and Northamptonshire forge £4 1s. and £4 2s. 6d. In some cases makers quoted higher figures, with the object, it is said, of postponing contracts in the hope of still better prices. Foundry iron has been bought more freely this week, but the inquiry for forge has not been greatly stimulated. Sellers of raw iron report a disposition on the part of consumers to enlarge their purchases. Where they took 25 to 50 tons, they now order up to 100 tons. The restriction of buying to ascertained requirements, it would therefore seem, is giving way to bolder enterprise. Iron has been sold down to the end of the year, and in special cases commitments run well into the first quarter of 1924, substantially higher prices than the minima lately ruling being payable on these transactions. Finished ironmasters maintain there is no accession of business to support the stiffening tendency of raw materials. They express misgivings as to the effect which the upward movement may have upon nascent demand. Smelters for their part continue to complain of the unprofitable character of business, and they realise that something more than an advance in selling prices is necessary before they can hope to put the blast-furnaces on an economic and level footing. There must be a cheapening of materials which the producer of crude iron has to buy, and a further lightening of the burden of transport charges. The position of the coke supply is still viewed with some apprehension. Most of the smelters have no doubt got to the end of the high-priced contracts that were made in the spring, when, with orders flowing in, blast-furnace owners were content to pay fancy prices for coke rather than be held up by the famine which the drain of supplies on the Continent threatened. To-day's price for furnace coke in the Midlands is 24s. at ovens. The cost is something like double pre-war delivered at the furnaces. The situation as regards supplies is to be reviewed at a conference of suppliers and blast-furnacemen, and it is hoped in the iron trade that further relief may be forthcoming. The issue, it is realised, still hangs upon the export trade. Meanwhile the price of Durham furnace coke has been reduced, and that is regarded as a favourable omen. It is interesting to note now that demand for raw iron is increasing now production has been curtailed in the Midlands during recent months. There are now sixteen furnaces active in Staffordshire and the immediate neighbourhood, against twenty-one four months ago; seventeen in Lincolnshire, against nineteen; thirty-eight in Derbyshire, Leicestershire, Nottinghamshire, and Northamptonshire, against forty.

Steel Values Hardening.

The steel market has hardened considerably. Users of billets have considered that the time has arrived to cover their prospective requirements, but they find the £7 15s. quotation a thing of the past. The minimum at date appears to be £8, while many large works want £8 5s. A number of sales of high-carbon billets have been made this week in larger quantities than for many months past at £10 to £10 5s. per ton, according to carbon content. Though the efforts to renew the association for price control in the small steel bar trade have not as yet come to much, prices have become more regular. Firms that were last week quoting £9 10s. are now asking £9 15s. Significant developments have taken place as between steel works and their customers. In the case of structural engineers, for example, where quotations are made on a pending contract, the prices named are allowed to stand usually for a few weeks to give time for the contracts to be placed. But it is now the rule for the manufacturing works to intimate that quotations must be accepted per return of post or they will be no longer valid. The position of the steel masters has strengthened considerably through recent bookings, and a large proportion of the plant is engaged in supplying semi-finished material for sheet and tin-plate rolling. There is an impression that prices will be advanced in the steel trade, and in the event of a settlement of the boilermakers' dispute higher prices are regarded as a certainty. The continued idleness of the boilermakers is the weak feature of the situation, accountable for some slackness at the mills rolling ship plates, &c. Makers of light plates are well booked for some time to come. Foreign competition in the steel department is very little in evidence just now, notwithstanding the reports of the lowering of continental prices. Belgian material is less freely offered than it was down to a week ago. Restraint is exercised in regard to forward buying, and this accounts in part for the small attention paid to the overtures of continental shippers.

Finished Iron Improvement.

The finished iron trade of this district is now beginning to feel just a slight benefit from the trade improvement. It is very little as yet and is confined for the most part to makers of best-class iron who have booked quite a number of substantial orders at £14 10s., the figure which has ruled for so long. The department dealing with nut and bolt iron, which has been under a cloud for months, is beginning to show, I am happy to state, some little improvement. A welcome feature is a disposition on the part of users to cover themselves for a month or two ahead, on the strength, no doubt, of a potential improvement in the nut and bolt industry. Competition is still exceedingly keen for bolt and nut bars, and in this district £10 12s. 6d. seems to be the maximum obtainable. Lancashire houses quote £10 15s. and in cases are able to get it, but when they come to sell on the Staffordshire market they are compelled to accept the lower figure or lose the business. Belgian shippers are again offering, this week's quotation being £7 17s. 6d. Antwerp, or about £9 delivered here. This is a reduction of about half-a-crown on last week's offers. Many of the finished iron mills in the district continue to be employed re-rolling steel, which is sharing in the trade improvement to a larger extent than manufactured iron. Wrought iron gas tube strip is only in moderate request at £12 10s. The tube trade is rather quiet at the moment.

Sheet Values Firm.

The galvanised sheet industry is vigorous. A steady flow of orders is coming in and the mills are assured of employment for some months. The stringency is not relieved, and some makers who have pledged their output as far forward as they are prepared to go have now closed their books as regards the thin gauges, which are in greatest demand. The price of ordinary 24-gauge galvanised corrugated sheets is firmer on the basis of £19 to £19 5s., f.o.b. Liverpool.

Rumoured Substantial Orders.

Trade in the Wednesbury district of the Black Country is showing a brighter tendency, and this week considerable attention has been paid to the rumours, apparently well founded, that substantial orders have been received at one of the largest works in Wednesbury. These are stated to include orders for bridges and for a large number of railway coach underframes.

Unemployment Still Declining.

It is gratifying to learn from the unemployment returns for the Midlands area that the number of persons out of work continues to decrease. The latest figures show a fall of 1394, which, with the reduction of 1275 recorded last week, brings the total of unemployed in the area down to 165,454, of whom 120,688 are men, 3786 boys, 36,031 women, and 4949 girls. In the Birmingham area, unfortunately, there is an increase of 127 as against last week's decline of 295. The number out of work in the Birmingham area is now 42,175, in Wolverhampton 8032, in Coventry 5581, Cradley Heath 5084, Smethwick 5383, Bilston 4010, and Walsall 6161.

Obituary.

Mr. Caleb W. Roberts, a member of the well-known Black Country firm of iron and steel manufacturers, Roberts and Cooper, Limited, died at his home at Brierley Hill on Sunday last. Mr. Roberts, who was forty-seven years of age, was actively connected with the iron side of the firm's business until about three years ago, when failing health compelled him to retire. He was well known in industrial circles in the Midlands, where he will be missed. Mr. Chas. E. Brettell has died at Littlehampton, where he had been living in retirement. He was formerly a partner of J. O. and C. E. Brettell, engineers, Worcester.

LANCASHIRE.

(From our own Correspondents.)

Manchester, Thursday.

General Conditions.

The markets for iron and steel have continued to show rather more strength this week, and there is certainly an improved feeling all round. Various circumstances have combined to bring about the change, amongst which may be mentioned the promise to place orders for cruisers, the hope that a good deal of the Government expenditure on behalf of the unemployed will come to the steel trade, and the probability that the long-drawn-out dispute with the boilermakers is to be settled. There is work waiting to be done in the shipyards which has been held up for a long time. One important consideration on the other side must, however, not be forgotten by those who seem to expect a permanent rise in prices, and this is, that there is a large amount of what may be called unemployed capacity in the iron and steel trades of the country. This has to be absorbed before the markets can be really safe, and if prices rise the process of absorption will certainly prevent them from rising very fast.

Metals.

A rather curious feature of the situation is that the improvement in the iron and steel trades not

reflected in the non-ferrous metal business, unless to a certain extent in tin and lead, although the advances in these two metals are probably quite unconnected with the iron and steel movements. Copper remains very depressed, and the inclination here to buy seems to become less as the metal gets cheaper. Of course, in the end, cheap metal will stimulate the consumption, as it always does in the long run; but at present buyers have no confidence in prices. The reason for the depression in copper is probably the state of affairs in America, where the actual consumption has been declining, but the output has been increasing. America no doubt feels very much the loss of the German outlet for copper, and recent political events in Germany suggest that it will be a very long time before that country recovers sufficiently to enable a resumption of copper consumption to take place. The recent fall in the value of sterling in relation to American currency ought to have had a stimulating effect on copper prices here; but so far no such effect can be seen, and one could scarcely have a better proof of the weakness of the American market. Tin has been a firm market, and the reduction of stocks in this country has given a good opportunity to those who are interested in "boosting" the prices; but a higher price in London will probably bring out more of the Eastern reserves of the metal, and in the absence of any growth in the consumption, one does not see that the price of the metal can go much higher. Spelter has kept steady and fairly firm, but the prices for this metal are now low in comparison with lead. The rapid advance in lead prices has taken the merchants here by surprise, and the general feeling is that lead is fast becoming a very dangerous metal to deal with. Up to the time of writing foreign lead has reached a higher price than has been known since November, 1920, when the market began to get rid of the absurdly high prices caused by the war. The outlook is not at all clear yet, but the fact that the "backwardation" on three months' lead is considerably over £3 per ton suggests that the present prices are caused by a squeeze for prompt metal made possible by small arrivals.

Pig Iron.

The demand in Manchester for foundry iron is certainly a little better than it was, and the month closes with both buyers and sellers in a more cheerful mood. There are a good many consumers who bought supplies of No. 3 iron when it was to be had from the Derbyshire furnaces at 90s. on trucks, and those who contracted up to the end of the year are well satisfied; but the bulk of the buying recently was for short periods, and a good deal of this is now being renewed because consumers have reached the conclusion that there is no reason to suppose that prices will be any easier for a month or two. Most sellers of Derbyshire are this week basing their Manchester price on 92s. 6d. at the furnaces, which makes the price in Manchester about £5 per ton. The price of Cleveland iron is about the same on trucks, but the position of supply is different in the Cleveland district. The drastic reduction of the output has left no iron in reserve, and the recent increase in the demand caused a much sharper rise there than in the Midlands, where some of the furnaces are not yet too well sold. Of course, it is clear that if the present advance in Cleveland is sustained we shall soon see more furnaces in blast; so that the view of most merchants here, viz., that the advance is temporary, has a good chance of proving correct. If there be any improvement in the foundry trade it is very slight at present, but ironfounders here deny that there has been an improvement.

Steel.

Sellers of manufactured steel here are a little firmer in their ideas, but so far there has not been any very definite and universal advance in prices. Steel makers have been selling at a loss for so long that they naturally try to get some advantage out of the better general feeling in the trade; but many works are short of orders and must compete keenly if they are to get a share of what is going. Hence prices in the steel trade appear irregular, and the quotations vary very much according as to how the selling works are situated in regard to orders in hand. Some sellers of steel plates here are quoting up to £10 10s. per ton, but there is little doubt that orders at £10 could still be placed. The official bar iron prices have not been altered, but there is a hope amongst makers that the great difference existing between bar iron and bar steel will be reduced.

Scrap.

There is a decided improvement in the scrap trade and dealers have been able to raise their prices. These were, no doubt, much more depressed than they ought to have been, and even after the recent improvement scrap prices are still very far too low. Some of the Lancashire malleable ironworks are now paying 85s. per ton delivered for heavy wrought scrap, and good cast scrap for the foundries is quoted at 85s. to 90s. per ton. There is a demand from Sheffield for Lancashire steel scrap, and dealers now talk of 75s. per ton on trucks. Not so long ago they would have been glad to get as much as 65s.

BARROW-IN-FURNESS, Thursday.

Hematites.

The position in the hematite pig iron trade of North Lancashire and Cumberland is one of fair strength. The recent improvement has been well maintained and the outlook is more promising than it has been for some time past. On general home account the demand, whilst not being of big proportions, is steady, and local requirements on the part of steel makers are satisfactory. The whole of the iron produced is going into immediate use and the stores of iron in some makers' yards have been largely drawn upon. There is no immediate prospect of any expansion in the way of output, but this may be necessary before the turn of the year. Continental wants are only small at present, and little is on offer on American account. It is noteworthy that this week iron prices have been advanced. Special iron is in small demand. Charcoal iron finds a ready sale, but the output is limited to one small furnace.

Iron Ore.

For iron ore there is a limited demand, for the trade is almost wholly concerned with local smelters. The importations of Spanish ore have been easy for some time. A fairly large cargo reached Barrow last week.

Steel.

There are no new features to report in the steel trade. At Barrow the output of steel rails, hoops, and sections is well maintained and the foundries are fairly well employed. There is a fair amount of activity in the Workington district. New business is still quiet, but some improvement is looked for.

Shipbuilding and Engineering.

There is a little more activity in some of the engineering shops at Barrow with the giving out of reconditioning work on guns for the British Government. A lot of work, however, is still held up in the shipbuilding departments consequent upon the long continuance of the boilermakers' lock-out. The prospect of Barrow sharing in the building of light cruisers has been a piece of welcome news to the district.

Fuel.

The demand for fuel is very quiet all round, both as regards steam coal and coke.

SHEFFIELD.

(From our own Correspondent.)

The Steel Trade.

ALTHOUGH a good deal of confidence is felt as to the future of the heavy steel trade, and the ex-Master Cutler has this week stated that a revival is in sight, there is not much change to report at present. The output of the local open-hearth furnaces has remained at much the same level since August, and a lot more work is wanted before the full capacity of the plant will be called upon. The railway steel departments continue to be among the busiest, but they are not by any means fully employed. A good deal of activity is displayed in the making of axles, buffers, tires, and springs, but in rails there is less regularity of work. Sheffield is, however, much interested to know that the United Steel Companies have booked, for their Workington establishment, the biggest order for rails received since August, 1914, and one which will be sufficient in itself to keep the rolling mills in operation one week in every four from January to September next. The news that the Government has decided to build several light cruisers is welcome, as this is sure to bring a great deal of work to Sheffield, and Admiral Sturdee's remark at the Cutlers' Feast, "If I am a prophet at all, I believe you will get more orders," is another cheering factor.

The Lighter Side.

Conditions in the crucible steel trade continue unsatisfactory. The demand for this expensive material, especially for the high speed variety, which is so much used in the manufacture of engineering tools, has been poor for a long time, and shows very slow progress towards a recovery of its normal state, although things are much better than they were a year ago, when the trade was down to a very low ebb. The majority of makers of tools and files also report that they are better employed than they were a year ago, but still no one is anything like busy, and a lot of leeway has to be made up. These trades will be among those to benefit greatly by the construction of the new warships.

Lincolnshire and South Wales.

There is much activity at the iron and steel works of Lincolnshire, which are busy turning out material for use in the tin-plate industry of South Wales. The general manager of the Normanby Park Steel Works, in a speech last week, said that he did not think there need be any fear of short work during the coming winter. South Wales is very busy, and is to-day the most active market for scrap, the prices of which have recently become firmer. At present, buying in this district is on a small scale, but, as supplies are restricted, holders are maintaining their prices, and are anticipating a brisk demand as soon as the steel trade shows a revival.

Cutlery and Plate.

There is a better tone in both these old industries. The call for stainless table knives, always one of the principal lines, has increased, not only from the Colonies but also from the home market, and a substantial quantity is being sent to London. An improvement in business in the scissors and pen-knife departments is also reported. A very good trade is being done with Australia, which continues to be the busiest of the markets overseas. The competition of German cutlery continues, but this is from stock in this country and not from new imports, with the result that prices have increased. The Sheffield trade in safety razor blades has become one of considerable importance, and should progress further, as the blades are equal in quality to the Americans and are a good deal cheaper. For knives used in the shoe, meat, and other trades, a good demand exists, while some satisfactory orders for matchets have come in lately. There is a good deal of slackness in the hollow-ware and Britannia metal departments, and those who are engaged in the former say that there is practically no Christmas season trade. In some branches of the plate industry, however, conditions are so much improved that firms, which have been on short time all the year, are extending their working hours and taking on additional hands. There are many Christmas orders, but these are principally for inexpensive goods, and the competition for them is so extremely keen that little or no profit is to be made.

An Order for Railway Cars.

The increase of traffic on the Mersey Railway has brought a welcome order to Sheffield. It has been found necessary to put into service two new motor cars for operating three and five-car trains; and a new five-car train, consisting of two motor and three trailer cars, has been ordered from Craven's Railway Carriage and Wagon Co., Limited, of Darnall, Sheffield. The train is of new design, and is to be constructed under the supervision of Mr. J. Shaw, general manager and engineer of the Mersey Railway. The seating capacity of the first-class car is 44 passengers, and of the third-class 48. The electrical equipment is to be supplied by the Metropolitan-Vickers Electrical Company, Limited, of Trafford Park, Manchester.

Proposed Improvements at Lincoln.

The question of improving the waterways of Lincoln has been before the city for some time, and a very interesting scheme, propounded by Sir William Tritton, of William Foster and Co., Limited, has been submitted to the City Council for consideration. The scheme provides for the removal of the swing bridge at Brayford Head, and the erection of a new lock there, which would make it possible to remove the existing block at Stamp End. All the property forming the Crown Yard at the end of St. Benedict-square has already been purchased by the Corporation, whose intention it is to widen the road at this point for heavy traffic from High-street to Brayford North. In order to continue the new road direct to Brayford, a much larger bridge would be necessary over Brayford Head to carry all the traffic. The present depth of the river, however, would preclude the possibility of such a bridge, and Sir William proposes that the river bed should be lowered some 3ft. 6in. from Brayford Head as far as Stamp End locks. This would allow the Corporation to effect further improvements in two of the city's main thoroughfares, for both the High Bridge and Magpies Bridge could be lowered, so that the "humps" at present encountered would disappear.

NORTH OF ENGLAND.

(From our own Correspondent.)

The Future of the Tees.

THE whole future of the river Tees is involved in a decision that is likely to be arrived at by the board of directors of the London and North-Eastern Railway Company as the outcome of a visit on Tuesday last for the purpose of inspecting the land acquired at Grangetown for new shipping facilities. The board's decision as to whether the land is to be utilised for the construction of a dock or a deep-water wharf is awaited with considerable interest by the commercial community on Tees-side. For many years past the trade of the Tees has been handicapped in no small measure by the inadequate dock facilities, and congestion has arisen causing delay and considerable additional expense to shipowners. It has also been found that the Middlesbrough Dock itself is generally unsuited for the type of steamer now using the port. The ordinary type of ship visiting the Tees nowadays approaches or exceeds 500ft. in length, and the wharves in the dock, which previously held two steamers, can now only accommodate one. As a result, vessels, instead of proceeding immediately to the wharves for loading or unloading, are delayed either in the river or in the Tees Bay for their turn to enter the dock. Many years ago the railway company purchased a large track of land on the Yorkshire side of the river at Grangetown, and the original proposal was to provide a deep-water wharf about a mile in length. This scheme, however, has received some opposition from the Tees Conservancy Commissioners, who, it is understood, are pressing their claim for construction of a dock. The chief point of the opposition is that the site of the proposed wharf is too exposed to allow it to be used with safety by large liners. There is nothing to break the force of the gales which blow across from the north-west, while there is also a danger of sand silting up to the wharf from the Seal Sands on the opposite side of the channel. Moreover, it is argued, the Commissioners would have to maintain a depth of 33ft. to ensure, as far as possible, the safety of liners lying alongside—a constant and costly task. According to the railway company's estimates, the construction of a wharf would entail an expenditure of £800,000 and that of a dock £1,800,000.

Cleveland Iron Trade.

The Cleveland iron trade presents few new features of moment. The position may be characterised as steady and firm, and though there is still a fair volume of business coming forward makers show no disposition to rush prices up merely to exploit the situation. Having established prices on a paying basis, makers are content with a narrow margin of profit and are not wishful to embark upon the very dangerous policy of squeezing the market. On the other hand, it is noted that Midland iron producers have advanced their prices, and with carriage added Derbyshire and Northamptonshire iron is now rather dearer than Cleveland. Thus there are no cheaper sources of supply for buyers elsewhere, and those having need of iron are readily paying 100s. for the standard quality. There is, however, no great quantity of iron available for early sale. On the contrary, the output is very restricted. No. 1 foundry iron is 107s. 6d., No. 4 foundry 99s., and No. 4 forge 98s.

Hematite Pig Iron.

There is a steady demand for East Coast hematite pig iron, but not more than makers can cope with. The South Wales steel makers have been buying freely in this district, and contracts are reported extending to the end of March next. The tendency is therefore towards higher levels, and 100s. is now the general quotation for mixed numbers, although a decent order can still be placed at 99s. 6d. per ton. The price of No. 1 hematite is now 101s. 6d. per ton.

Ironmaking Materials.

The very restricted consumption of foreign ore and the continued heavy deliveries under contract leave consumers under no necessity to buy. On the contrary, their stocks have in many cases assumed embarrassing proportions, and only occasionally do they need to buy a cargo for mixing. Best Rubio is still nominally at 23s. per ton c.i.f. Tees. Coke prices are steady and unchanged, good Durham furnace coke varying from 30s. to 40s. per ton delivered at the works.

Manufactured Iron and Steel.

The Northern manufactured iron and steel trade still maintains a healthy tone, and there is no doubt that with a settlement of the shipyard dispute very active conditions would prevail. Some big rail orders are reported to have been placed, and all the winter work schemes are having a favourable influence, and engineers and others are placing contracts more freely. Prices are all very firm, but unchanged.

Work for Wear Shipyard.

Messrs. John Brown and Sons, shipbuilders, Sunderland, have booked an order from Walter Runciman, Limited, of Newcastle, for a vessel with a deadweight carrying capacity of 3000 tons. This is the second order obtained by the same firm from Messrs. Runciman during the last fortnight.

The Coal Trade.

There are no very outstanding alterations in the Northern coal trade situation, but there is not the same settled and assured tone in the market, and a little anxiety as to the forward outlook is being shown in some quarters. The political disturbances in Germany, together with the strikes at Hamburg and elsewhere, are having an unsettling effect, and tend to retard shipments, to say nothing of hampering new business. However, favourable reports are now coming to hand in regard to the strike position in Germany, and as work is being resumed the movements of tonnage there should be freer. It is said that American competition is again keen and menacing in Italy and the Mediterranean area generally, and is rather interfering with the outlook in the gas and coking coal trade. This is already beginning to have effect in the forward values, though any alteration in that way is slight as yet. But there is no doubt about the American effort to secure trade at almost any cost. The market for Northumberland steam coals is unchanged and remains very satisfactory. All brands of best steam coals are well sold and are firm in price, which applies more or less equally to every make of second screened steams. The Durham gas coal trade is not so well situated as it was a week ago, and prices show a tendency to ease. A number of inquiries are reported to be in hand or in course of preparation for large quantities of coking coals for shipment to France over the whole of next year, but whether these result in actual business remains to be seen. The coke market is variable, being easy for nearly every make of beehive or patent oven coke, but for gas coke there is a good demand and prices are still inclined to rise.

SCOTLAND.

(From our own Correspondent.)

A Brighter Aspect.

In view of the relief schemes announced by the Government, the outlook has assumed a brighter aspect, which is reflected in the more hopeful feeling which pervades the steel, iron, and allied trades. No doubt some time must elapse before contracts can reach the works, but at any rate there is something to look forward to. Apart from road schemes and railway work, the announcement of work for the Clyde is of particular interest. The big shipbuilding yards are perhaps not altogether unemployed, but, judged by their capacity, are next door to it. A cessation of the boilermakers' dispute would also mean added activities. While orders are not so prolific as formerly, a fair number of contracts could be proceeded with, and it is hoped that orders which have been cancelled will be renewed. Peace at the shipyards would soon have a beneficial effect on unemployment in the Clyde area and would ultimately affect the steel and ironworks. The latter should also benefit to some extent by the proposed work in connection with the railway schemes. The commencement of the new road between Glasgow and Edinburgh will also give employment to thousands of men for a period of about two years. It is said that wages will account for the bulk of the expenditure. The Glasgow Corporation will be responsible for about 25 miles of the new route, and the Edinburgh Corporation for the remaining portion. While the work is to be done by the Corporations, it will be by contract and not by direct labour.

Pig Iron Firmer.

The Scotch pig iron markets have been a shade livelier during the past few days. Both home and export inquiries have been better and buyers have shown more disposition to purchase for future requirements. Hematite remains on a firm basis, while foundry qualities have returned to their level of a few weeks ago.

Steel Plates and Sections Unchanged.

No improvement is yet reported in the inquiries for steel plates or sections. Specifications for plates are especially scarce, and while prices are nominally unaltered, it is said that some makers are prepared to accept a considerably less figure. Sections are not quite so poorly bought as plates, but transactions are still confined to comparatively small quantities.

Light Steel Sheets Active.

The activity in light steel sheets is apparently undiminished. In most cases makers are well booked for some time ahead for export. They, however, would welcome business in the heavier plates.

Shale Miners Accept Reduction.

The shale miners employed by Scottish Oils, Limited, have by a large majority decided to accept the reduction proposed of 12½ per cent. on tonnage rates and the abolition of time and a-half for week-end work. The Scottish Oil Workers' Association has also accepted the reduction of 3d. per day proposed by the company, with a minimum wage of 7s. per day.

Bar Iron: Continued Quietness.

Nothing has occurred to improve the position at the bar ironworks. Only a small business is being done, both home and export inquiries being extremely scarce at present. Crown quality bars are unchanged at £12 per ton for home delivery, but something in the region of £11 per ton can be done for export. Re-rolled steel bars are in slightly better demand.

Coal: Firm Export Prices.

Continued firmness characterises the export department of the Scotch coal trade. The collieries in all districts are heavily sold for most descriptions of round fuel for export, the output being almost entirely taken up for a fortnight ahead. Consumers had been more disposed to cover their winter requirements, and already some business had been done for December delivery; but the enhanced prices now quoted by owners have created a considerable amount of hesitancy with regard to dealings for future delivery. Lanarkshire ells, splints, and steams, and all grades of Lothian and Fifeshire steams show an increase in price. In all districts washed nuts are more plentiful and are selling well at easier prices. Despite a scarcity of small shipping tonnage, the loading docks on the East Coast are busy, especially at Methil and Leith, where there is a turn of about a week. Aggregate shipments for the past week amounted to 322,608 tons, against 324,356 tons in the preceding week and 341,445 tons in the same week last year. The home market is busier owing to increased demands for gas, electricity, and railway purposes.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

The conditions prevailing in the steam coal export trade are practically identical with those in evidence a week ago. The general demand has not materially expanded, and prices remain, with few exceptions, on the same level. The position of individual collieries has, of course, undergone some alteration, just as their tonnage has come to hand, but the weather has been very bad, and certainly steamers have not come to port in the numbers that were expected. Some of the collieries were hoping that delayed tonnage would have come to hand and thus enable them to refuse some of the low prices that are offered them for coals, if not assist them to ask with some degree of confidence for higher prices. This is scarcely the case except possibly in isolated instances. Since writing a week ago a substantial amount of further business has been done in coals for delivery over 1924, and it is a very fair estimate to say that at least a million and a-half tons have been contracted for. Additional business has been arranged in superior second Admiralty large at 27s. 6d., and in good second Admiralty large at 26s. 9d. Those collieries which have sold on this basis have now closed their books at these figures and are now quoting higher prices. It seems, however, that some of the firms which regularly go in first and contract for coals over the following year, such as some of the foreign depôt-owning firms, have not yet bought. A number of them have done so, but certainly one or two have not, and this fact shows the difference of view held regarding the prospects of business over 1924. Undoubtedly the outlook is extremely uncertain, and a good case can be made out either for buying or refraining to do so. It all depends how matters are looked at. It seems to be generally held that no great rise in values can be calculated upon next year such as was brought about by labour troubles in America; but it is quite on the cards that Germany will want coals in view of the somewhat remote prospects of the Ruhr question being settled quickly, while so far as the Allied countries are concerned, they cannot wait indefinitely for increased Reparation deliveries. Buyers in France, Italy and Belgium have certainly been holding off in the expectation of receiving Reparation coals, but they have been disappointed so far, and there seems to be no hope of speedy supplies. The point has to be borne in mind also that coalowners are likely to have increased costs in respect of labour, and although the prices they have so far obtained represent practically 1s. per ton over current year's prices, it is fairly certain that if prices show any indication of coming below this level collieries would have seriously to consider the advisability of continuing working, as for very many of them it would mean doing so at a loss.

Miners and their Wages.

The demands of the miners in respect to their wages and the revision of the national agreement have now been made known. They are that the owners' standard profits shall be 13 per cent. of the standard wages instead of 17 per cent.; that the surplus, after meeting the standard costs, shall be divided between wages and profits in the ratio of 87 to 13, instead of 83 to 17; that further information as to costs other than wages shall be given, and that the minimum rate of wages shall be 40 per cent. instead of 20 per cent. above the 1914 earnings. The demands are much on the lines that were expected. As regards South Wales the movement for the revision of the agreement and higher wages has received and will receive an impetus from the fact that the wage rate for November and December has dropped back practically to the minimum. The certificate of the joint accountants for the months of July and August gives the general wage rate payable for the next two months as 28.66 per cent. on the 1915 standard rate, which compares with 41.47 per cent. which has been in operation during September and October. The figures are very disappointing, although not altogether unexpected. It is estimated that the fall in the percentage will mean a loss to the miners of South Wales of about £50,000 weekly. The case of the "rebel elements" in the coalfield will be strengthened, and already they have moved. On Saturday last there was a conference at Cardiff called by the South Wales Miners' Minority Movement, when resolutions were passed demanding the immediate calling of a coalfield conference for the purpose of deciding to give fourteen days' notices to terminate contracts to fight for a living wage and a new agreement, and that no future agreements containing profit-sharing clauses whereby wages could only be secured as long as profits to the owners were secured should be entered into between the miners and the coalowners. So far as the South Wales coalowners are concerned, their chairman told the representatives of the South Wales Miners' Federation, at a meeting of the Conciliation Board on Tuesday, that they had already decided to call a meeting with a view to ascertaining what could be done to improve the industry.

Tin-plate Cloud.

Reference was recently made to the threats of trouble in the tin-plate industry and to the postponement of notices, but the engine drivers and firemen, &c., have again met and decided to hand in twenty-eight days' notices as from Monday next. Unfortunately, the union representatives have been unable to arrive at terms considered satisfactory by the men. The workmen in question are not numerous, but they are keymen, which means that if effect is given to their decision works will not be able to carry on.

Current Business.

The tone of the steam coal market continues very irregular. The position of collieries varies considerably owing to the fact that tonnage delayed by the recent bad weather has not come to hand as was expected last week-end, and in the early part of this week there were vacant loading berths at various docks. The inquiry for coals for early delivery is very quiet so far as continental buyers are concerned, but at the same time there are inquiries in circulation for cargoes for shipment over the next two or three months and for the first three months of next year. Outside of these there is an inquiry from the Central Argentine Railways for 150,000 to 200,000 tons of Cardiff large steam coals for delivery over the whole of next year. So far as current prices are concerned these are on the basis of 27s. 6d. for best Admiralty large and 26s. to 26s. 6d. for second qualities, while superior smalls are round about 17s. 6d. to 18s. 6d. Patent fuel meets with very little demand, and as regards anthracite the tone is quieter, especially for large coals, while duff is very firm. Sized coals keep about steady.

Latest News from the Provinces.

THE MIDLANDS AND STAFFORDSHIRE.

Disappointment for Ironmasters.

Ironmasters in the Midlands are extremely disappointed at the result of the further conference which has just taken place between their representatives and those of the coke suppliers with regard to the price of blast-furnace coke. The arrangement arrived at a month ago to lower the price from 26s. per ton to 24s. per ton at ovens applied only to October. Hopes, as I state in my letter this week, were entertained in the iron trade that more favourable terms would be obtainable for the month of November. The suppliers do not see their way to another reduction however. They are still able to sell a large proportion of their output to the Continent at prices appreciably higher than that which rules at home, and the increasing strength of the pig iron market at home is another factor which no doubt weighs with them. Accordingly, they have intimated to the blast-furnace owners that for the present the price of 24s. per ton at ovens must stand.

WALES AND ADJOINING COUNTIES.

Coals for Germany.

It is reported that a large share of Germany's coal and coke requirements has been placed with Baldwins, Limited, and Stephenson, Clarke and Co., Limited, the latter firm being, jointly with the Powell Duffryn Steam Coal Company, Limited, the holders of the share capital of the Maris Export and Trading Company, of Cardiff, which has already shipped large quantities of coal and coke to Germany. No confirmation of the business is yet obtainable, and it is stated that so far arrangements have not been completed for the opening of the necessary credits in London.

CONTRACTS.

The Selson Engineering Company, Limited, of Selson House, 83 and 85, Queen Victoria-street, London, E.C. 4, has received from the London, Midland and Scottish Railway Company, Crewe, a contract for a number of its "Selson" patented central thrust high-speed radial drilling machines, 4ft. 6in. size, with double spindle, and also 7ft. size.

The Leeds Forge Company, Leeds, has received an order from the Great Indian Peninsula Railway for the supply of 206 bogie hopper ballasting wagons. The wagons are of a type specially designed by the Leeds firm for track ballasting purposes, and are similar to those supplied some years ago to the same railway. In addition to the foregoing the Leeds Forge Company has, during the last six weeks, received orders for 350 grain wagons for South Africa and 50 steel coaches for New South Wales.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	19/6 to 26/-
(1) Spanish	23/-
(1) N. African	23/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	23/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	5 5 0	—
No. 1 Foundry	5 5 0	—
No. 3 Foundry	5 0 0	—
N.E. Coast—		
Hematite Mixed Nos.	5 0 0	5 0 0
No. 1	5 1 6	5 1 6
Cleveland—		
No. 1	5 7 6	5 7 6
Silicious Iron	5 7 6	5 7 6
No. 3 G.M.B.	5 0 0	5 0 0
No. 4 Foundry	4 19 0	4 19 0
No. 4 Forge	4 18 0	4 18 0
Mottled	—	—
White	—	—
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	9 2 6	—
North Staffs. Forge*	—	—
„ „ Foundry	4 12 6 to 5 0 0	
(3) Northampton—		
Foundry No. 3	4 12 6	—
„ Forge	4 1 0 to 4 2 6	—
(3) Derbyshire—		
No. 3 Foundry	4 12 6 to 4 15 0	
Forge	4 4 0 to 4 5 0	
(3) Lincolnshire—		
No. 3 Foundry	4 13 0	—
No. 4 Forge	4 10 0	—
Basic	4 11 0	—
(4) N.W. Coast—		
N. Lancs and Cum.—		
Hematite Mixed Nos.	(5 12 0 (a) / 5 17 0 (b)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	12 0 0	—
Best „	—	—
N.E. Coast—		
Crown Bars	12 0 0	—
Tees	10 0 0	—
Lancs.—		
Crown Bars	12 0 0	—
Second Quality Bars	11 5 0	—
Hoops	15 0 0	14 15 0
S. Yorks.—		
Crown Bars	12 0 0	—
Best „	13 0 0	—
Hoops	14 10 0	—
Midlands—		
Crown Bars	12 0 0 to 12 10 0	
Marked Bars (Staffs.)	14 10 0	—
Nut and Bolt Bars	10 12 6 to 10 15 0	
Gas Tube Strip	12 10 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	13 0 0	—
Ship Plates, ¼in. and up	10 0 0	—
Sections	9 15 0	—
Steel Sheets, 5/16in. to ¼in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	18 17 6

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	9 15 0	—
Angles	9 5 0	—
Boiler Plates	13 0 0	—
Joists	9 10 0	—
Heavy Rails	9 10 0	—
Fish-plates	12 10 0	—
Channels	9 5 0	—
Hard Billets	10 5 0	—
Soft Billets	9 0 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 10 0†	—
Light „	9 0 0 to 9 10 0†	
Billets	8 10 0 to 11 10 0†	
Manchester—		
Bars (Round)	10 5 0 to 10 10 0	
„ (others)	10 0 0 to 10 2 6	
Hoops (Best)	15 5 0	15 0 0
„ (Soft Steel)	13 15 0	13 10 0
Plates	10 0 0 to 10 10 0	
„ (Lancs. Boiler)	13 10 0	—
Sheffield—		
Siemens Acid Billets	12 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	10 5 0	—
Intermediate Basic	10 0 0	—
Soft Basic	8 0 0	—
Hoops	12 10 0	—
Soft Wire Rods	11 10 0	—
Midlands—		
Small Rolled Bars	9 10 0 to 9 15 0	
Billets and Sheet-bars	8 0 0 to 8 5 0	
Gas Tube Strip	10 10 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	19 0 0 to 19 5 0	
Angles	9 10 0	—
Joists	9 10 0	—
Tees	10 10 0	—
Bridge and Tank Plates	10 0 0 to 10 5 0	

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	23/1½ to 23/3
Block Tin (cash)	206 5 0
„ (three months)	203 7 6
Copper (cash)	59 17 6
„ (three months)	60 7 6
Spanish Lead (cash)	31 10 0
„ (three months)	28 0 0
Spelter (cash)	33 10 0
„ (three months)	32 12 6
Manchester—	
Copper, Best Selected Ingots	63 15 0
„ Electrolytic	64 10 0
„ Strong Sheets	92 0 0
„ Tubes (Basis price)	0 1 1
Brass Tubes (Basis price)	0 0 11¾
„ Condenser	0 1 2
Lead, English	32 0 0
„ Foreign	31 10 0

FERRO ALLOYS.

(All prices now nominal.

Tungsten Metal Powder	1/9 per lb.	
Ferro Tungsten	1/5 per lb.	
	Per Ton.	Per Unit
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	10/6
„ 6 p.c. to 8 p.c. „	£21 0 0	8/-
„ 8 p.c. to 10 p.c. „	£20 0 0	8/-
„ Specially Refined		
„ Max. 2 p.c. carbon	£50 0 0	18/-
„ „ 1 p.c. „	£60 0 0	21/-
„ „ 0.75 p.c. carbon	£65 0 0	22/6
„ carbon free	1/6 per lb.	
Metallic Chromium	4/- per lb.	
Ferro Manganese (per ton)	£18 for home, £20 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 10 0	scale 5/- per unit
„ „ 75 p.c.	£18 10 0	scale 6/- per unit
„ Vanadium	18/- per lb.	
„ Molybdenum	9/- per lb.	
„ Titanium (carbon free)	1/1 per lb.	
Nickel (per ton)	£130	
Cobalt	11/6 per lb.	
Aluminium (per ton)	£82 to £100	

(British Official.)

FUELS.

	Export.
SCOTLAND.	
Lanarkshire—	
(f.o.b. Glasgow)—Steam	23/-
„ „ Ell	24/-
„ „ Splint	24/6 to 25/9
„ „ Trebles	25/6
„ „ Doubles	24/-
„ „ Singles	22/9
Ayrshire—	
(f.o.b. Ports)—Steam	23/-
„ „ Splint	24/6
„ „ Trebles	24/6
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	22/- to 24/3
Screened Navigation	27/6
Trebles	26/3
Doubles	23/-
Singles	21/-
Lothians—	
(f.o.b. Leith)—Best Steam	24/-
Secondary Steam	23/9
Trebles	24/9
Doubles	23/6
Singles	22/6
ENGLAND.	
(8) N.W. Coast—	
Steams	29/-
Household	46/6 to 57/6
Coke	43/6
Northumberland—	
Best Steams	25/- to 26/6
Second Steams	22/6 to 23/-
Steam Smalls	15/- to 16/6
Uncreened	20/6
Household	25/- to 28/-
Durham—	
Best Gas	24/-
Second	22/6 to 23/6
Household	25/- to 28/-
Foundry Coke	50/- to 52/6

Sheffield	Inland.	
Best Hand-picked Branch	31/- to 32/-	—
Barnsley Best Silkstone	27/6 to 29/-	—
Derbyshire Best Brights	27/- to 29/-	—
„ „ House	23/- to 24/-	—
„ „ Large Nuts	21/- to 22/6	—
„ „ Small „	15/- to 16/-	—
Yorkshire Hards	21/- to 23/-	—
Derbyshire „	20/- to 22/-	—
Rough Slacks	11/6 to 13/6	—
Nutty „	10/- to 12/-	—
Smalls	7/- to 9/-	—
Blast-furnace Coke (Inland)	32/- to 33/-	
„ „ (Export)	f.o.b.	36/- to 37/-

Cardiff— (9) SOUTH WALES.	
Steam Coals :	
Best Smokeless Large	27/6 to 28/-
Second „ „	26/- to 27/-
Best Dry Large	27/- to 28/-
Ordinary Dry Large	26/- to 27/-
Best Black Vein Large	26/6 to 27/-
Western Valley „	25/- to 26/-
Best Eastern Valley Large	24/- to 25/-
Ordinary „ „	23/- to 24/-
Best Steam Smalls	17/6 to 18/6
Ordinary „	16/- to 17/-
Washed Nuts	27/6 to 30/-
No. 3 Rhondda Large	28/- to 29/-
„ „ Smalls	24/- to 25/-
No. 2 „ Large	23/- to 24/-
„ „ Through	18/6 to 19/6
„ „ Smalls	16/- to 17/-
Coke (export)	42/6 to 50/-
Patent Fuel	29/- to 32/-
Pitwood (ex ship)	28/6 to 29/6
Swansea—	
Anthracite Coals :	
Best Big Vein Large	45/- to 47/6
Seconds	35/- to 37/6
Red Vein	32/6 to 35/-
Machine-made Cobbles	57/6 to 60/-
Nuts	57/6 to 60/-
Beans	45/- to 47/6
Peas	27/- to 28/-
Breaker Duff	12/9 to 13/-
Rubbly Culm	14/6 to 15/-
Steam Coals :	
Large	24/- to 25/-
Seconds	22/- to 23/-
Smalls	14/- to 16/-
Cargo Through	19/- to 21/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow.

(8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

* Quotations extremely high and nominal. † Latest quotations available. (a) Delivered Sheffield or Glasgow. (b) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

Commercial Vehicles.

THE exhibition of commercial vehicles being held in the Grand Palais this week shows that the motor wagon is less specialised in this country than in some others. There are a few firms which only build motor wagons, but as a rule their construction is regarded as a subsidiary branch of the business, and the design follows more or less the lines of the small chassis. On the other hand, there are some makers, like Delahaye, who have been obliged to develop particularly the heavy vehicle department. Still, apart from Schneider and Saurer, there has been little attempt at specialisation, though where it has been made the wagon has made decided progress, particularly in providing means for ensuring the greatest possible security. Accidents that have taken place during the past season to heavy passenger touring vehicles have shown the necessity for giving closer attention, for instance, to steering gears and brakes. In the case of the Saurer wagons, the question of brakes has been specially investigated, and while the engine itself is designed to be used safely for braking purposes, compressed air brakes have been applied to all four wheels, although it does not appear that they are yet a regular equipment of the Saurer vehicles. The Latil wagon is another purely commercial type which has for many years proved the economy and efficiency of front driving wheels, whereby the whole of the mechanism is carried under the bonnet and the driver's seat, leaving the frame behind free for the fitting of ample bodies, low down between the wheels. One of the vehicles shown had a metallic body, with sliding covers of the type employed for the removal of refuse in Paris. The sectional covers are moved along as the vehicle is loaded, and, when full, the contents are entirely enclosed. Several hundreds of these vehicles, built by different makers, are employed by the company which undertakes the collection and removal of Paris refuse.

Haulage Economy.

The question of fitting pneumatic tires to wagons is being considered by some makers, since the trials carried out on a number of Paris motor omnibuses gave satisfactory results, and a big wagon on the Panhard stand was fitted with such tires; but while there are certainly advantages in employing them they have been criticised on the ground that they are unsuitable for vehicles that may be mobilised for military purposes. It is largely on account of its military value that the endless track system of vehicle is meeting with so much vogue. In the trials carried out recently by the Ministry of War with agricultural tractors for which subsidies are granted to buyers, the only vehicles that secured awards were the Renault and the Citroën-Kergesse. Both of these endless track vehicles were shown in the Grand Palais in a military guise, and it is curious that the research for a suitable vehicle for hauling guns and army wagons should be influencing the adoption of one type of agricultural tractor. So far as the farmer is concerned, the payment of subsidies will not induce him to purchase tractors of a particular type, unless it be proved sufficiently economical, and it is curious that, following upon the active propaganda in favour of cheap fuels carried out during the past year or two, so little evidence of progress in this direction should be observable in the Grand Palais. Suction gas plants have certainly been successful, and quite a number of them are being used, but there was only one vehicle equipped with a suction gas plant in the show, from which it may be concluded that manufacturers, at all events, are not particularly anxious to develop this branch of the business. In the same way, the heavy oil engine seems to be at a standstill, so far as motor vehicles are concerned. High first cost, and the necessity of placing the engine in skilled hands, may have had something to do with retarding its adoption. Fuel cost is, indeed, an increasingly serious problem for the motor car user, who is finding no relief, even from the employment of the so-called "national fuel," composed of a mixture of petrol and alcohol. Nevertheless, commercial vehicles must be used, and they are employed in greater numbers than ever. Some big users are finding it very economical to employ a tractor of the type of the American "Quads" for running continuously with a number of trailing vehicles. The Chenard-Walcker and the Latil are the only tractors of this type built in France.

Cold Storage.

The value of cold storage has only been recognised in this country during the past few years. It was previously discredited in the interests of the home industry, which was protected against the importation of chilled meat. The prejudice still exists to a certain extent, but apart from the importation of frozen meat, which is now permitted, it is found that cold storage has become a necessity for home produce, and a large number of installations are being laid down in the ports as well as in the different distributing centres. At present there are eighteen cold storage plants, having a capacity of 90,000 tons, and the railway rolling stock includes 2250 wagons of the isothermic type. There are also thirty-seven steamers equipped for the cold storage of about 50,000 tons. The vogue for cold storage is rapidly spreading, and is providing plenty of activity to manufacturers of refrigerating plants.

Ruhr Stocks.

Statements that British metallurgical firms are alarmed at the prospect of the stocks of rolled iron and steel seized in the Ruhr being off-loaded on to the British market hardly seemed justified in view of the fact that, after providing for the requirements of the liberated regions, the quantity of material remaining for disposal would not be much more than 80,000 tons. The French Government has given an assurance that the material will not be offered for sale in England, and it appears probable even that the stocks will be returned to the Ruhr owners as soon as all the conditions required for the cessation of the "passive resistance" are carried out. It is worth noting that the French have been showing an increasing regard for the interests of British manufacturers since the active protectionist policy showed the possibility of restrictions being placed upon the British market.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

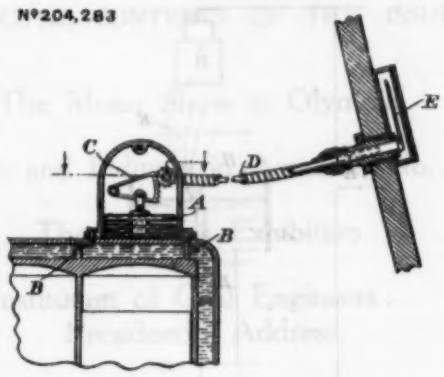
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

204,283. April 16th, 1923.—MEASURING WATER JACKET TEMPERATURES, *H. A. Gill*, 51–52, *Chancery-lane, London, W.C.2.*

The inventor proposes to indicate the temperature of the cylinders of internal combustion engines by means of a thermostatic element A. This element is mounted in direct contact

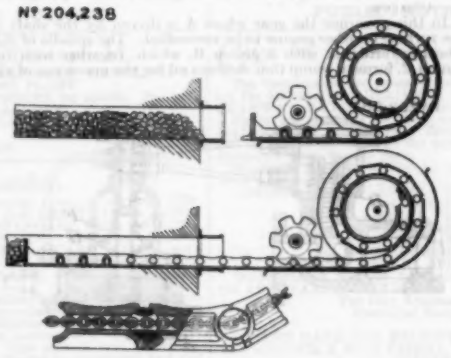


with the jacket, and bridge pieces B B are provided to make metallic connection between the cylinder itself and the face on which the element is mounted. Expansion of the fluid contained in the thermostatic element operates the quadrant C, which, through the flexible shaft D, moves the indicating pointer E.—*September 27th*, 1923.

GAS PRODUCERS.

204,238. November 17th, 1922.—DISCHARGING COKE FROM GAS RETORTS, R. A. Williams, 29, Lawrence-street, Newark, Notts.

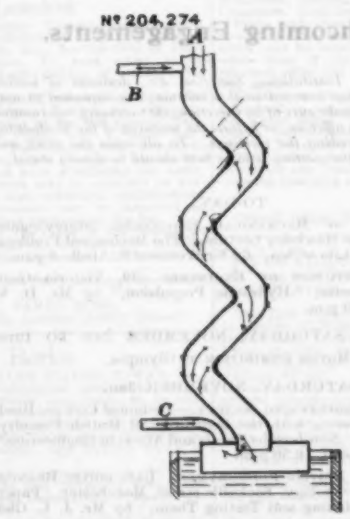
This invention is concerned with apparatus for discharging coke from horizontal or inclined through gas retorts of the type which includes a jointed ram or pusher rigid in operation, but capable of being wound on a drum. The ram consists of jointed



sections or articulated block links with pivot or fulcrum pins between the sections or block links, and a chain or wire rope running through and housed within the jointed sections and pivot pins, and adapted to hold the jointed parts together, as well as to take up any slack due to wear of the parts.—*September 27th*, 1923.

204,274. March 16th, 1923.—GAS CLEANING APPARATUS, N. M. Anderson, Haslev, Denmark.

The chief peculiarity of this gas scrubber, which is intended for

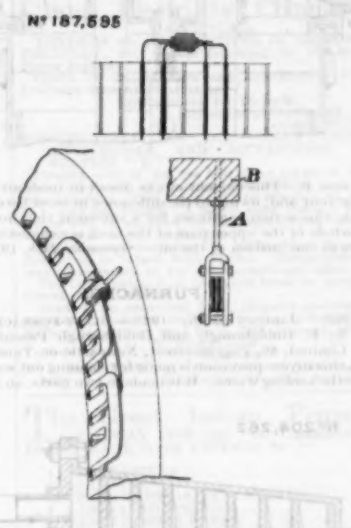


treating gas particularly rich in tar, is the fact that the gas and the water used for cleaning it both descend through the apparatus in the same direction. It comprises, essentially, a zigzag tube of approximately rectangular cross section, into which the raw gas is fed at A. The water is introduced at B and an outlet for cleaned gas is provided at C. Hand holes are arranged opposite the bends for cleaning purposes.—*September 27th*, 1923.

DYNAMOS AND MOTORS.

187,595. October 11th, 1922.—IMPROVEMENTS IN OR RELATING TO INDUCTION MOTORS, Ateliers H. Cuénod, Société Anonyme, of Châtelaine-Geneve, Switzerland.

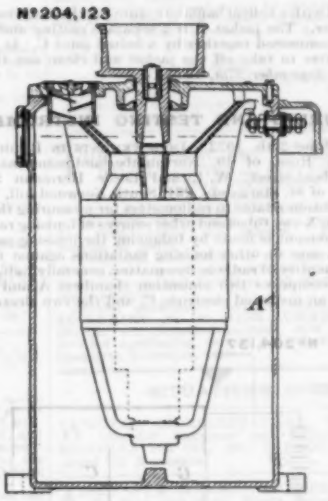
It often happens that the windings of induction motors are subjected, while the machine is running, to influences which are instrumental in the destruction of the usual electrical insulation of electro-motors. These influences may be caused by an excessive amount of moisture in the air or a specially high temperature



of the air or the motor may be situated in a place to which have access gases or vapours which attack the ordinary insulation of the windings, and in time destroy them. The essential feature of the invention is that the winding of the stator of an electro-motor is supported freely with respect to the grooves, and the ends of the stator frame, so that an air space is formed between the frame and the winding in each of the grooves and at each end of the frame, as shown in the drawings, the clamping device A being attached to the casing B.—*September 27th*, 1923.

204,123. June 21st, 1922.—IMPROVEMENTS IN OR RELATING TO DYNAMO-ELECTRIC MACHINES, Gustavus McAlpine and Alfred Kendal Toulmin-Smith, both of Air Ministry, Alexandra House, Kingsway, London.

According to the invention, a direct-current dynamo-electric generator or motor is mounted in an oil bath A, so as to run immersed in oil, the armature preferably being finished with a smooth exterior surface to reduce oil friction and churning, and the brushes being made with a slightly abrasive action and the commutator segments being arranged with a defined entering



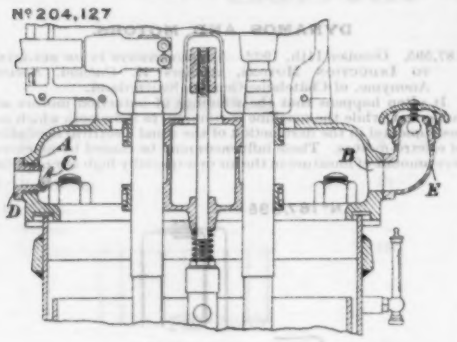
edge to break down any oil film under the brushes. In lieu of using oil, other suitable inert liquids may be used, such, for example, as poly-chloro-derivatives of ethane and ethylene or mixtures thereof. A direct-current dynamo electric machine mounted in this way will not fire an explosive atmosphere, or absorb moisture or gases from the atmosphere, and has high insulation properties, and in the case of a high-tension machine flashing around the commutator is prevented. The arrangement is thus applicable for use in flying boats or other aircraft, submarines and mines, but is also applicable for use in other localities where normal conditions apply.—*September 21st*, 1923.

SWITCHGEAR.

204,127. June 23rd, 1922.—IMPROVEMENTS RELATING TO OIL-IMMERSED ELECTRIC SWITCHES, CIRCUIT-BREAKERS AND THE LIKE, William Anselm Coates, of 36, Hartington-road, Chorlton-cum-Hardy, Lancaster, and Metropolitan-Vickers Electrical Company, Limited, of 4, Central-buildings, Westminster.

This invention relates to oil-immersed electric switches, circuit breakers and the like and has for its object to provide improved means for venting the space above the oil. The upper part of the tank of an oil-immersed switch or circuit breaker is provided with at least two vents, A and B, which open to the atmosphere at different levels, the lower vent being normally open and provided with a non-return valve, which is adapted to close the vent when the pressure within the tank exceeds a predetermined amount and the upper vent being permanently open. When an arc occurs at the opening of the switch, a considerable amount of gas is liberated, and the increased pressure within the tank causes the valve C to close the vent pipe D, the gases then escaping only by way of the vent pipe E. When

sufficient gas has escaped to relieve the pressure within the tank to a predetermined extent, the weight of the valve C, which may in some cases be assisted by a spring, causes it to fall and open the vent D, while there is still a stream of gas issuing through

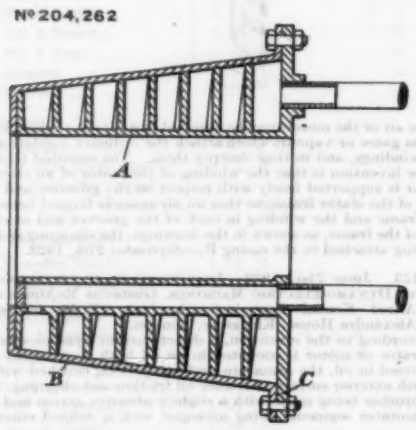


the vent E. This current of gas draws in fresh air through the lower vent and, owing to the difference in level between the two vents, this action continues for a sufficient time to ensure that the whole of the upper part of the tank is exhausted of the products of combustion of the oil.—*September 24th*, 1923.

FURNACES.

204,262. January 25th, 1923.—Blast-furnace Tuyeres, R. E. Goldsbrough and Goldsbrough Patents Company, Limited, 86, Pilgrim-street, Newcastle-on-Tyne.

In this tuyere provision is made for cleaning out scale deposited from the cooling water. It is made in two parts, an inner section

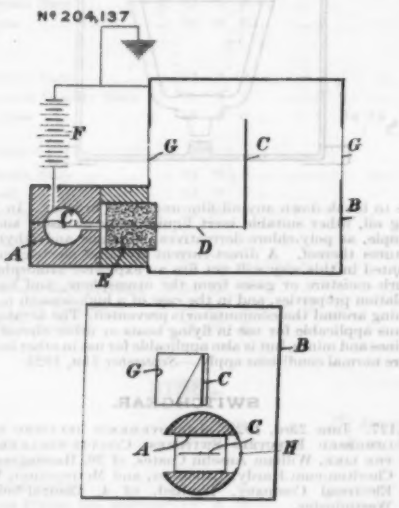


A provided with a helical baffle to ensure the thorough circulation of the water. The jacket B is a separate casting and the two pieces are connected together by a bolted joint C. It is thus a simple matter to take off the jacket and clean out the water passages.—*September 27th*, 1923.

MEASURING AND TESTING INSTRUMENTS.

204,137. June 26th, 1922.—Improvements in Radiometers, Sidney Russ, of 19, Northumberland-mansions, Northumberland-street, W. 1, and Leslie Hermann Septimus Clark, of St. Margarets, 234, South Norwood-hill, S.E.

The invention relates to radiometers for measuring the output of rays from X-ray tubes and other sources of ionising radiations. The measurement is made by balancing the ionising power of a beam of X-rays or other ionising radiations against that of a specified quantity of radio-active matter, generally radium. The apparatus comprises two ionisation chambers A and B, each containing an insulated electrode C, and the two electrodes are

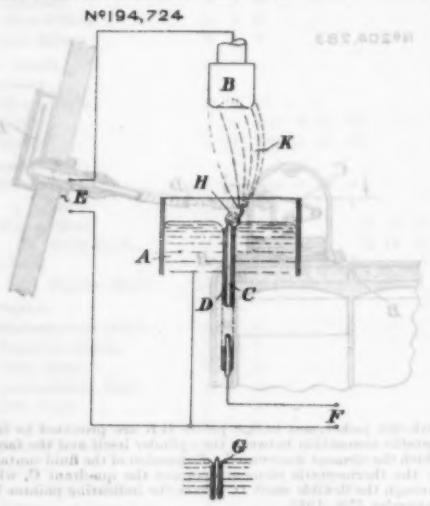


connected to each other by a wire D, which passes through an insulating plug E between the two chambers. The chamber A is a lead cylinder, having the electrode along its axis, and having its ends closed by very thin mica windows, coated with aluminium leaf. The lead cylinder is disposed within a housing having openings facing the mica windows. One of these openings is somewhat smaller in diameter than the cylinder, and has a diaphragm with a minute lead disc H at its centre, so that it will allow an annulus of radiation, say, from an X-ray tube, to enter the chamber A and pursue a direct air path to the further window, without impinging upon the wall of the cylinder or the axial electrode. The electrode C in the chamber B is in the form of a stem with a gold leaf suspended therefrom, to act as an electroscope. Two windows G in opposite walls of the chamber face the electrode, and another wall of the chamber is of very thin aluminium leaf, to allow entry of a radiation from a small mass of radium. The chambers A and B are connected respectively to the terminals of a battery F and the chamber B is earthed. The deflection of the gold leaf may be observed through a tele-microscope or the image of the leaf may be projected on a screen. The mass of radium used and the size of the ionisation chambers are determined by the limits between which the instrument is used.—*September 26th*, 1923.

MISCELLANEOUS.

194,724. March 12th, 1923.—Improved Means for Exciting and Igniting the Arcs in Metal Vapour Rectifiers, Aktiengesellschaft Brown, Boveri et Cie., of Baden, Switzerland.

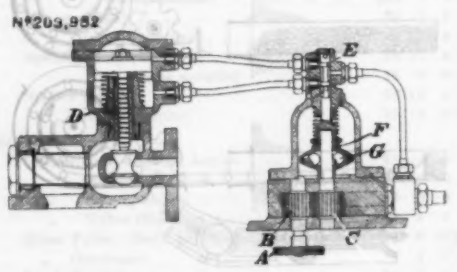
This invention relates to improved means for exciting and igniting the electric arcs in metal vapour rectifiers. A conductor C, composed of tungsten, is introduced into the cathode mercury A. The conductor is surrounded by an insulating substance D,



and between the cathode A and anode B the supply leads E are connected. An auxiliary supply is also provided at F. Before starting the rectifier, the mercury A of the cathode makes contact with the upper end of the conductor C, by means of a small annular contact G. When the auxiliary current is switched on, the contact surface becomes heated, and a small arc H is formed, and this starts the main arc K by ionisation.—*September 20th*, 1923.

203,982. January 27th, 1923.—Governor Mechanism, Sir H. Reid, Bart., 110, Flemington-street, Springburn, Glasgow.

In this governor the gear wheel A is driven by the shaft of the turbine or other engine to be controlled. The spindle of this wheel is furnished with a pinion B, which, together with the pinion C, forms a pump that delivers oil for the operation of the



throttle valve D. The supply of oil to the throttle is regulated, according to the speed of the engine, by the valve F, which, in turn, is controlled by the governor F. The governor comprises two dish-shaped plates, between which there are balls G. The bottom dish is fixed axially, and is grooved radially to accommodate the balls. The upper dish is fixed on the spindle of the valve E, which it operates in accordance with the centrifugal action of the balls.—*September 20th*, 1923.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Institution of Mechanical Engineers.—Storey's-gate, S.W. 1. Thomas Hawksley Lecture, "The Mechanical Problems of the Safety of Life at Sea," by Sir Westcott S. Abell. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Lecturette, "Hydraulic Propulsion," by Mr. D. V. Hotchkiss. 7.30 p.m.

FRIDAY TO SATURDAY, NOVEMBER 2ND TO 10TH.

Commercial Motor Exhibition at Olympia.

SATURDAY, NOVEMBER 3RD.

Bradford Engineering Society.—Technical College, Bradford. Joint meeting with the Institution of British Foundrymen. Lecture, "Non-ferrous Metals and Alloys in Engineering," by Mr. E. L. Rhead. 6.30 p.m.

Institute of British Foundrymen: Lancashire Branch.—College of Technology, Sackville-street, Manchester. Paper, "Test Bars: Making and Testing Them," by Mr. J. L. Glen Primrose. 4 p.m.

Junior Institution of Engineers: North Kent Section.—Dining Hall of J. and E. Hall, Limited, Dartford. Presidential address, "Some Problems Connected with the Transmission and Controlling Mechanism of the Tanks" (slides), by Major W. G. Wilson. 8 p.m.

MONDAY, NOVEMBER 5TH.

Bradford Engineering Society.—Technical College, Bradford. Lecture, "Jigs and Fixtures," by Mr. T. Elliott. 7.30 p.m.

Institute of Transport.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2. Fourth annual general meeting. Paper, "A Transport Adventure in Persia," by Mr. T. Salkield. 5.30 p.m.

Royal Institute of British Architects.—1, Wimpole-street, W. 1. Inaugural meeting. Address by the President. 8.30 p.m.

Royal Institution of Great Britain.—Albemarle-street, Piccadilly, W. 1. General monthly meeting. 5 p.m.

Society of Engineers.—Rooms of the Geological Society, Burlington House, Piccadilly, W. 1. Paper, "Lubrication," by Mr. W. Lee. 5.30 p.m.

TUESDAY, NOVEMBER 6TH.

Institute of Marine Engineers. 85–88, The Minories, Tower-hill, E. 1. "Gear Cutting," by Messrs. R. J. McLeod and T. Calderwood. 6.30 p.m.

Institution of Civil Engineers.—Great George-street, S.W. 1. Presidential address by Sir Charles Langbridge Morgan. 6 p.m.

WEDNESDAY, NOVEMBER 7TH.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, W.C. 2. Wireless Section meeting. Inaugural address by the chairman, Mr. E. H. Shaughnessy. 6 p.m.

Institution of Heating and Ventilating Engineers.—The Engineers' Club, Coventry-street, W. 1. Lecture, "Some Common Faults in Fan Design and Application," by Mr. F. G. Whipp. 7 p.m.

Institution of Railway Signal Engineers.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2. Paper, "Signalling Colours," by Messrs. F. R. Lenkshear and A. F. Bound. 6.30 p.m.

Royal Society of Arts.—John-street, Adelphi, W.C. 2. Inaugural address, "Exhibitions," by Lord Askwith. 8 p.m.

THURSDAY, NOVEMBER 8TH.

Institute of Metals, Royal School of Mines, South Kensington, S.W. 7.—Lecture: "Some Impressions of American Non-Ferrous Metallurgy," by Dr. W. Rosenhain.

FRIDAY, NOVEMBER 9TH.

Institute of Metals: Sheffield Local Section.—Mappin Hall of the University, St. George's-square, Sheffield. Sorby Lecture on "Metallurgical Problems, Present and Future," by Dr. W. Rosenhain, F.R.S. 7.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Lecturette, "Amateur Cinematography," by Dr. C. K. Mees. 7.30 p.m.

SATURDAY, NOVEMBER 10TH.

Finsbury Old Students' Association.—The Engineers' Club, Coventry-street, London, W. 1. Twelfth annual dinner. 7 p.m.

MONDAY, NOVEMBER 12TH.

Institute of Metals: Scottish Local Section.—Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Paper, "Nickel Alloys," by Mr. D. Turner. 7.30 p.m.

TUESDAY, NOVEMBER 13TH.

Institute of Marine Engineers.—85–88, The Minories, Tower-hill, E. 1. Adjourned discussion on "A Note upon Cast Iron for Marine Engine Castings from the Metallurgical and Engineering Points of View," by Messrs. H. J. Young and F. Wood. 6.30 p.m.

Institute of Metals: Birmingham Local Section.—Chamber of Commerce, New-street, Birmingham. Paper, "X-rays and Crystal Structure," by Dr. H. B. Keene. 7 p.m.

Institute of Metals: North-East Coast Local Section.—Armstrong College, Newcastle-on-Tyne. Paper, "General Scientific Brassfoundry Work," by Mr. P. Longmuir. 7.30 p.m.

WEDNESDAY, NOVEMBER 14TH.

Institution of Chemical Engineers.—The Engineers' Club, Coventry-street, W. 1. Papers: "A Study of the Conditions of Constant Rate of Flow in Filter Presses," by Messrs. M. B. Donald and R. D. Hunneman; "A Study of the Absorption Tower," by Messrs. M. B. Donald and C. W. Tyson. 7.30 p.m.

FRIDAY, NOVEMBER 16TH.

Institute of Metals: Sheffield Local Section.—The University, St. George's-square, Sheffield. Paper, "Substitutes for Platinum," by Mr. E. A. Smith. 7.30 p.m.

Institute of Metals: Swansea Local Section.—University College, Singleton Park, Swansea. Paper, "The Density of Alloys," by Professor T. Turner. 7.15 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Annual general meeting. 7.30 p.m.

Society of Chemical Industry: Chemical Engineering Group.—Chemical Industry Club, 2, Whitehall Court, S.W. 1. Paper: "A New Source of Potash, and its Industrial Exploitation," by Professor J. W. Hinchley. 8 p.m.

SATURDAY, NOVEMBER 17TH.

Junior Institution of Engineers.—Visit to the carriage and repair depôt of the Underground Railways at Acton. 2 p.m.

TUESDAY, NOVEMBER 20TH.

Institute of British Foundrymen: Lancashire Branch, Burnley Section.—Municipal College, Ormerod-road, Burnley. Paper, "The Founding of Admiralty Gun-metal and Allied Alloys," by Mr. F. W. Rowe. 7.15 p.m.

THURSDAY TO THURSDAY, NOVEMBER 22ND TO 29TH.

Public Works, Roads and Transport Exhibition.—At the Royal Agricultural Hall, Islington, N. 1.

FRIDAY, DECEMBER 7TH.

Junior Institution of Engineers.—Royal Society of Arts. Presidential address by Sir J. Fortescue Flannery, "Marine Propulsion during Fifty Years." 7.30 p.m.

The Institution of Automobile Engineers.—At the last meeting of the Council of the Institution of Automobile Engineers it was announced that the utility prize of £25, offered by Lieut.-Colonel D. J. Smith for the paper read before the Institution adjudged to be of greatest utility to the automobile industry, had been awarded by the judges to Mr. H. S. Rowell for his paper on "Principles of Vehicle Suspension."